From: kmerrill@knrd.org
To: "Bray, Dave" <Bray.Dave@epa.gov>
Date: 10/4/2016 4:16:58 PM
Subject: RE: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

Hi Dave,
Yes for sure more info is needed. Here are some documents on the Mississippi Silicon plant which Bryan Holtrop of your staff found earlier and a draft impact statement for a new facility in Iceland. I will send you the Spokane Tribe's Class 1 Airshed Redesignation submittal document with the next email for your records.
Thanks --Ken

Ken Merrill
Water Resources Program
(509) 447-7276 (office)
(b) (6) [redacted] (cell)

From: Bray, Dave [mailto:Bray.Dave@epa.gov]
Sent: Thursday, September 29, 2016 2:23 PM
To: Ken Merrill; Wilson, Wenona
Subject: RE: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

Thanks Ken.

Interesting stuff.

If we do end up doing some screening modeling, our modeler will need to get some more detailed information from the company (or Ecology if they've got something from the company yet).

Look forward to talking more soon.

Dave

David C. Bray
Associate Director for Air
Office of Air and Waste
EPA Region 10
Seattle, WA
(206) 553-4253

From: Ken Merrill [mailto:kmerrill@knrd.org]
Sent: Wednesday, September 28, 2016 2:44 PM
To: Wilson, Wenona <Wilson.Wenona@epa.gov>
Cc: Bray, Dave <Bray.Dave@epa.gov>
Subject: RE: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

FYI- Attached is some info on the smelter project sent to us by the project proponent. PM numbers are omitted for some reason --Ken

Ken Merrill
Water Resources Program
(509) 447-7276 (office)
(b) (6) [redacted] (cell)

From: Ken Merrill
Sent: Tuesday, September 27, 2016 4:46 PM
To: Wilson, Wenona
Cc: 'Bray, Dave'; Zach Welcker; Deane Osterman
Subject: Preliminary screening model for air impacts from Smelter near Kalispel Reservation

Hi Wenona,

Thank you for your time today, and as we discussed, the Tribe needs to understand how the proposed smelter might impact the home of the Kalispel people and understand how a redesignation of the Tribes airshed to Class 1 might affect the PSD permitting outcome and the Tribe's air quality. If there were a way that EPA could help to do some screening modeling, we think it would help the Kalispel develop the capacity to best protect our right to clean air on the reservation.

Thanks for the consideration --Ken

Kenneth R. Merrill
Manager - Water Resources Program
Kalispel Tribe Natural Resources
PO Box 39, Usk, WA, 99180
(509) 447-7276 (office)
(b) (6) (cell)

Kalispel
natural resources

10/11/2018

Kalispel
natural resources

10/11/2018

Kennedy/Jenks Consultants

1515 East Woodfield Rd. Suite 360
Schaumburg, Illinois 60173
847-278-7705

Application for Prevention of Significant Deterioration (PSD) Air Permit

14 August 2013

Prepared for

MISSISSIPPI SILICON

Mississippi Silicon, LLC
Proposed Silicon Manufacturing Plant
50 Industrial Drive
Burnsville, MS 38847

K/J Project No. 1341008*00

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Section 1: Introduction

Mississippi Silicon, LLC. (MS Silicon) is proposing the construction of a silicon manufacturing plant located near the city of Burnsville, in Tishomingo County, Mississippi (Figure 1-1). The silicon manufacturing plant is being constructed to produce revolutionary low-cost, high-quality silicon allowing MS Silicon to meet the ever-increasing demand for its silicon. The new facility will enable MS Silicon to produce silicon metal so it can be sold to the company's existing and new customers in the global market.

Several factors were important influences on this choice of site:

- Burnsville is centrally located to both the raw material suppliers and finished product customers for Mississippi Silicon.
- The site is located on the Tennessee-Tombigbee Waterway, with a barge loading and unloading facility immediately adjacent and available for Mississippi Silicon to use for inbound materials and outbound product, if desired. The Tennessee- Tombigbee Waterway provides direct access to both the Gulf of Mexico and the Ohio River.
- A high-voltage TVA line runs past the western boundary of the site. TVA will be a stable, reliable, low-cost long-term supplier of the most important production input for Mississippi Silicon, electricity. The proximity of this power line will minimize the cost and facilitate the link to this input.
- Mississippi has a large and sustainable supply of wood, an important raw material in Mississippi Silicon's production process.
- The state of Mississippi, Tishomingo County, and the TVA enthusiastically support the project, and are providing significant financial incentives to demonstrate that support.

The plant will provide jobs for nearly 150 people. When operational, MS Silicon's Mississippi facility has the potential to catalyze significant economic development for Tishomingo County and the state. The project will also create an estimated 500 construction jobs during the peak period of its construction.

The silicon manufacturing plant being proposed by MS Silicon will be capable of producing a high quality, low cost silicon. The manufacturing plant will utilize four (4) semi-enclosed submerged arc furnaces (SAF) with a capacity of 2.75 tons/hr each (~45 MVA) to produce approximately 84,096 tons/year of 98-99% pure silicon metal. The plant will incorporate into its design proven and highly efficient control technologies and techniques for the reduction of potential emissions of regulated air pollutants. In order to create the silicon metal, quartz, coal, and wood will be processed in the SAF.

The silicon manufacturing plant will involve specific process areas including raw material receiving, handling and storage operations along with operations associated with the actual silicon manufacturing process. The primary process operations associated with silicon manufacturing will include:

- Raw material handling, storage and conveyance (coal, wood, quartz and limestone);

- Loading of these raw materials into four (4) semi-enclosed submerged arc furnaces (SAF) (electric fired) to produce liquid silicon metal (approximately 98% pure); and
- Using ladles and casting molds to produce solid silicon metal (approximately 98% pure).

The process areas that will have the potential to emit regulated air pollutants include:

- Material handling and transfer to and from coal, wood and quartz storage piles;
- Storage yard for coal, wood and quartz storage piles;
- Raw material day bins to support the semi-enclosed submerged arc furnaces;
- Four (4) semi-enclosed submerged arc furnaces (SAF) with four (4) baghouses; and
- Four (4) natural gas-fired ladle pre-heaters.

The following plantwide operations and activities will have the potential to emit regulated air pollutants:

- Tank farm;
- Fugitive emissions from roadways;
- Slag handling;
- Silica fume silos:
- Facility-wide miscellaneous operations; and
- Emergency generator.

The operations identified above reflect a phased construction. Phase I will involve the installation of two (2) SAFs and supporting operations. At the completion of Phase I, MS Silicon will initiate construction of Phase II which will involve the installation of two (2) additional SAFs and supporting operations.

Collectively, these process areas will have the potential to emit major levels of regulated air pollutants and, therefore, will be subject to the Prevention of Significant Deterioration (PSD) regulations of the United States Environmental Protection Agency (USEPA) along with the requirements of the Mississippi Department of Environmental Quality (MDEQ) Air Pollution Code (APC), which contain air quality requirements that must be satisfied prior to construction of this type of plant. Appropriate air pollutant emission controls/techniques to minimize potential emissions of regulated air pollutants, appropriate measurements, testing and recording of operational parameters will be performed to confirm that the plant's major source levels of regulated air pollutant emissions are being achieved. The regulatory requirements imposed by the PSD and MDEQ air regulations, as well as emissions controls/measurements and compliance testing will ensure that the proposed silicon manufacturing plant will have no adverse impact to human health and welfare.

1.1 Summary of the Proposed Silicon Manufacturing Project

The proposed project will involve the construction and operation of a silicon manufacturing plant to be located in Tishomingo County, near the town of Burnsville. The proposed silicon manufacturing plant will be constructed in two (2) phases. After completion of both phases, the manufacturing plant will utilize four (4) semi-enclosed submerged arc furnaces (SAF) with a capacity of 2.75 tons/hr each (~45 MVA) to produce approximately 84,096 tons/year of 98-99% pure silicon metal. The proposed project will have the potential to emit regulated air pollutants in sufficient quantities (i.e., tons/year) to trigger the PSD regulations**.** Potential emission of regulated air pollutants at the conclusion of Phase II are summarized below:

Regulated Air Pollutant	**Potential to Emit Emission Rate (tons per year)**
Sulfur Dioxide (SO_2)	2,170.1
Nitrogen Dioxide (NO_2)	1,906.2
Carbon Monoxide (CO)	1,444.3
Particulate Matter (PM)	104.1
Particulate Matter (<10 microns) (PM_{10})	81.6
Particulate Matter (<2.5 microns) ($PM_{2.5}$)	73.1
Volatile Organic Compounds (VOC)	93.5
Lead (Pb)	< 1.0
Regulated HAPs	9.9 (individual), 13.9 (total)
Greenhouse Gases (CO_2e)	402,396.76

Based on the proposed plant's potential emission rates defined above, the proposed silicon manufacturing plant will have the potential to emit regulated air pollutants in excess of 100/250 tons/year and will be considered a Major Stationary Source. Since Tishomingo County is considered attainment for all regulated criteria air pollutants, PSD review was triggered for emissions of SO_2, NO_2, CO, PM_{10}, $PM_{2.5}$, VOCs, and GHGs from the proposed silicon manufacturing plant. The proposed silicon manufacturing plant will be considered Major under the PSD program, as well as under the Title V Operating Permit Program. The proposed silicon manufacturing plant will be considered a minor stationary source of regulated HAP emissions as defined under EPA's Title III program.

As part of the project, the potential air pollutant emission sources associated with the proposed silicon manufacturing plant will implement Best Available Control Technology (BACT) and as a result will not have an adverse impact on human health and welfare. Sections of this application provide the results of the air quality demonstration showing the plant will have no adverse impact on human health and welfare. The proposed silicon manufacturing plant will be implementing the following BACT control measures:

- A baghouse will be installed to control particulate matter on the plant's Submerged Arc Furnaces (SAF) to reduce the potential quantity of $PM/PM_{10}/PM_{2.5}$ emissions. One baghouse will be installed for each individual SAF;

- A baghouse(s) will be installed to control particulate matter from raw material handling to reduce the potential quantity of $PM/PM_{10}/PM_{2.5}$ emissions;
- A baghouse(s) will be installed to control particulate matter from product handling to reduce the potential quantity of $PM/PM_{10}/PM_{2.5}$ emissions;
- Utilization of natural gas as the primary combustion fuel in the ladle pre-heaters associated with the proposed plant. This is the cleanest burning fossil fuel and inherently reduces emissions of regulated air pollutants when compared to other fossil fuels such as coal and oil;
- Implementation of a Fugitive Dust Control Plan to minimize potential emissions of $PM/PM_{10}/PM_{2.5}$ from becoming airborne from various support operations associated with the plant (i.e., slag handling, raw material handling, paved and unpaved roadways);
- Installation of low NO_x burner technology or design on the plant's natural gas combustion devices to reduce potential emission of oxides of nitrogen (NO_x);
- Inclusion of bin vent filters on silica fume silos to reduce potential $PM/PM_{10}/PM_{2.5}$ emissions;
- Energy efficiency techniques to reduce the plant's overall potential for formation of greenhouse gas emissions (GHG);
- Implementation of testing, monitoring, recordkeeping and reporting requirements to ensure the plant will operate in compliance with applicable regulatory requirements and will not cause or contribute significantly to an exceedance of air quality standards developed by EPA to protect human health and welfare.

1.2 Site Information

The proposed silicon manufacturing plant will be located near the town of Burnsville in Tishomingo County, MS. Figure 1-1 shows a county map of Mississippi including the location of the proposed site in Tishomingo County. Figure 1-2 identifies the location of the proposed plant in relationship to Burnsville, MS while Figure 1-3 depicts an aerial view of the proposed plant location. Refer to Figure 2-1 for a general process area layout.

This site was selected based on a variety of factors including existing infrastructures, as well as new infrastructures being constructed in the vicinity of the site. Some of these critical infrastructures are listed below:

- Existing electrical transmission lines;
- Existing natural gas;
- Close proximity to major roadways to allow supply trucks easy access into and out of the proposed plant site;
- Rural location; and

- Located away from sensitive receptors such as hospitals, schools, nursing homes, and highly populated residential areas.

1.3 Anticipated Construction Schedule

The proposed plant will be constructed in two phases, Phase I and Phase II. Provided below is a tentative schedule related to construction and operation of these phases:

- Initiate construction of Phase I – November 2013;
- Complete construction of Phase I and commence operation – November 2015;
- Initial construction of Phase II – Spring 2015; and
- Complete construction of Phase II and commence operation – Spring 2017.

1.4 Maximum Design Silicon Production Rates

The proposed plant will have the following maximum design short term and long term production rates for silicon:

- Short Term (tons/hour)
    - Maximum Hourly Rate – One (1) SAF – 2.75 tons/hour
    - Maximum Hourly Rate – Four (4) SAFs – 11 tons/hour
    - Typical or Average Rate – One (1) SAF – 2.4 tons/hour
    - Typical or Average Rate – Four (4) SAFs – 9.6 tons/hour
- Long Term (tons/year)
    - Maximum Annual Rate – One (1) SAF – 21,024 tons/year
    - Maximum Annual Rate – Four (4) SAFs – 84,096 tons/year.

1.5 Regulatory Drivers – Permission to Construct the Plant

As discussed above, the proposed silicon manufacturing plant will have the potential to emit PSD major levels of regulated air pollutants. New equipment and operations which emit air pollutants within the MDEQ jurisdiction are subject to pre-construction review and approval by MDEQ pursuant to the APC-S-2 Permit Regulation for the Construction and/or Operation of Air Emissions Equipment.

The proposed plant will also be subject to other requirements contained within MDEQ's air quality regulations as well as EPA's federal air quality regulations (i.e., New Source Performance Standards (NSPS) and Maximum Achievable Control Technology (MACT). These regulations impose specific requirements and standards for stationary sources of air pollutants. Detailed discussions of these regulations as they pertain to the air pollutant sources at the proposed plant are provided in Section 3.

According to MDEQ APC-S-2-1-D, “Permitting Requirements”, any new stationary source or modification of a stationary source must have a permit to construct or multi-media permit incorporating such permit before beginning construction.

The construction application (as specified in the MDEQ application instructions and MDEQ regulations) must include the data and information necessary to demonstrate that the proposed project, which includes new sources of air pollution, complies with applicable air quality regulations and standards.

1.6 Application Requirements – Construction Application and Instructions

The construction application should include and identify the following:

- **GENERAL FORM** – Includes name, address and contact for the owner/applicant and the facility. Also includes the SIC code, number of employees, principal processes, principal products and raw materials, and operating schedule. This form also requires the signature of a registered official.

  Refer to Appendix A which includes the completed MDEQ application forms.

- **All operations or equipment having air emissions**. Specify the maximum schedule, maximum operating rate and expected operating rate, if different from the maximum.

  Refer to Section 2 of this application which identifies operations/equipment having the potential to emit regulated air pollutants, including supporting calculations and documentation.

- **Emission Rates** (in units of applicable emission standard as well as pounds per year and tons per year for each pollutant subject to regulations that can be reasonably expected to be emitted from each emission point. Emission rate calculations must be provided. The following emission rates shall be provided in the Emissions Summary Section of the form:

  - Potential uncontrolled emissions; and
  - Proposed emission rate (maximum emission rate).

  Refer to Section 2 of this application which identifies operations/equipment having the potential to emit regulated air pollutants, including supporting calculations and documentation.

- **Exhaust or Stack Parameters** for each emission source (height, velocity, diameter, and temperature) should be provided in the Emissions Summary Section of the form.

Refer to Section 2 of this application which identifies operations/equipment having the potential to emit regulated air pollutants, including supporting calculations and documentation.

The following additional information must be submitted in duplicate:

- **Design Calculations and Specifications** including all data and calculations used in selecting or designing process and control equipment;

- **Site Drawings** must be to scale and show at least the following:

    - Property involved with dimensions, clearly defining restricted entry boundaries, and if different, total property boundaries;

    - Location and identification of all existing and/or proposed buildings, structures, and/or equipment, including points of discharge of air contaminants to the atmosphere, drawn to scale and in proper orientation;

    - Dimensions (length, width) of all buildings, structures, and/or equipment, including emission points;

    - Elevation of all buildings, structures, and/or equipment, including emission points, showing heights, grade baseline, and grade baseline height above mean sea level;

    - Primary compass direction indicator; and

    - Location of streets and all adjacent properties. Show location of all buildings outside the property that are within 150 feet of the equipment involved in the application. Identify all such buildings, specifying number of stories, or approximate height, and indicate the prevailing wind direction.

  Refer to Sections 1 and 2 of this application for site drawings related to the proposed plant.

- **Construction Drawings** should be an assembly drawing, dimensioned and to scale, in as many sections as needed to show clearly the design and operation of the equipment and the means by which air contaminants are controlled. The following must be shown:

    - Size and shape of equipment. Show exterior and interior dimensions and features; and

    - Locations, sizes, and shape details of all features which may affect the production, collection, conveying or control of air contaminants of any kind: location, size and shape details concerning all materials handling equipment.

- **Description of Process and Control Equipment** – Include a written description of each process at the facility and the function of the equipment used in the process. Descriptions must be complete and particular attention must be given to explaining all stages in the process where the discharge of any materials might contribute in any way to air pollution. Control procedures must be described in sufficient detail to show extent of control of air contaminants anticipated in the design, specifying the expected efficiencies of the captures systems and control devices. All obtainable data must be supplied concerning the nature, volume, particle size, weights, chemical composition and concentrations of all types of air contaminants; and

- **Block Flow Diagram** – Include a drawing showing the steps of the process and the flow of materials through the process and any control devices.

- Additional information may be required as necessary to evaluate the design adequacy of the facility or to comply with PSD regulations.

  Refer to Section 2 of this application for process related information and diagrams related to the proposed plant.

The following sections are also required for a PSD application:

- **Applicable Requirements** - Provide compliance evaluations for all applicable state, federal and local air pollution control requirements including applicable requirements in MDEQ Regulations, federal new source performance standards, and national hazardous air pollutant standards. **(Refer to Section 3).**

- **BACT -** Provide a demonstration that proposed air pollution control devices and measures comply with Best Available Control Technology (BACT) requirements. **(Refer to Section 4).**

- **Air Quality Impacts Analysis -** Provide an ambient air quality impacts analysis based on modeling facility emissions using EPA approved air dispersion models. The modeling analysis should conform to current EPA modeling guidelines and recommended methods. **(Refer to Section 5).**

- **PSD Threshold Determination** - Provide a PSD threshold determination. **(Refer to Section 3).**

- **Additional Impact Analysis –** Provide an additional impact analysis.

  Refer to Sections 2 through 6 of this application for the design calculations/specifications and appropriate impact analysis.

MS Silicon, based on discussions held during the pre-application meeting with MDEQ and the application requirements listed above, is not aware of any additional information that is required for this application to be deemed complete.

The information required, as listed above, is provided in this construction permit application. It is MS Silicon's understanding that applications containing the required information should satisfy MDEQ's requirements for a complete application.

MS Silicon is confident that it has designed the proposed silicon manufacturing plant such that emissions from the facility will meet the requirements of MDEQ standards and rules, as well as the requirements defined by USEPA. Sufficient information is included in this application to provide MDEQ with reasonable assurance that the standards and rules will be met.

1.7 Application Review Timeline

It is our understanding that upon submission of this application, the MDEQ will conduct a complete and thorough review of its contents to ensure that the plant and its associated air emissions sources will:

- Meet all applicable state and federal air quality regulations and requirements;
- Not cause an adverse impact to human health and welfare; and
- Will employ best available control technologies (BACT) and implement appropriate testing, monitoring, recordkeeping and reporting that will ensure future minimal impacts to human health and welfare.

Upon completing this review, a construction permit will be proposed by the MDEQ (containing specific emission limitations, testing, monitoring, recordkeeping, and reporting requirements) and will be provided to the public including EPA Region IV for review and comment, prior to final issuance. The permit to be issued will allow for construction and limited operation. An operating permit will have to be obtained upon final construction of the plant.

1.8 Request for Construction Permit Issuance

MS Silicon is hereby requesting that MDEQ issue a construction permit to allow for construction of the regulated air pollutant emitting units associated with a stationary source (i.e., the proposed plant). It is MS Silicon's understanding that as defined in MDEQ APC-S-2-1-C-27 "stationary source" is defined as:

> *"Any building, structure, facility, or installation which emits or may emit regulated air pollutant(s)."*

MS Silicon understands based on the definition of "stationary source" contained in APC-S-2 that it is not allowed to perform any construction, installation, or establishment of any stationary source without an approved construction permit.

Upon the completion of construction or installation of an approved stationary source or modification, MS Silicon will notify the MDEQ that construction or installation was performed in accordance with the approved plans and specifications on file with the MDEQ.

The following individual will be the primary contact for answering any questions MDEQ may have related to the application request for construction:

Contact Name: Mr. Steven Frey

Phone Number: 847-278-7705

Email: stevefrey@kennedyjenks.com

It is anticipated that MS Silicon will initiate construction of the project in the November of 2013 and begin operation within 20 to 24 months of commencing construction. MS Silicon hereby agrees as part of the construction issuance process to meet the design criteria as accepted by MDEQ and to abide by the MDEQ rules regarding the quantities and types of materials to be discharged from the installation of the proposed silicon manufacturing plant

1.9 MDEQ Requirements for Public Involvement

It is MS Silicon's understanding that the public will be given an opportunity to express their interest in the construction permit application prior to approval by MDEQ. A brief summary of the involvement is provided below, reflecting MS Silicon's understanding of the public notice requirements. If this understanding is incorrect, MS Silicon is requesting that MDEQ provide appropriate guidance:

- Availability for public inspection in at least one location in the area affected of the information submitted by the owner or operator and of MDEQ's analysis of the effect on air quality;

- A 30-day period for submittal of public comment; and

- A notice, by prominent advertisement in the area affected, of the location of the source information and analysis.

A copy of the notice will be sent to the Administrator of EPA through Region IV, and to all other state and local air pollution control agencies having jurisdiction in the region in which such new or modified installation will be located. A permit to construct issued pursuant to this paragraph is federally enforceable.

1.10 Contents of This Application Request

To assist the MDEQ in approval and issuance of a construction permit, the following information is provided in this application request:

- **Section 2: Description of Proposed Plant** - This section contains a description of the process equipment, a description of control technologies and methods to be used, a description of the methods used to estimate the potential emissions of regulated air pollutants, and tables summarizing the estimated potential to emit (PTE) regulated air pollutant emission rates;
- **Section 3: Regulatory Applicability** - This section discusses the pertinent federal, state, and local air pollution control regulations that may be applicable to the proposed plant. This section also provides a PSD threshold determination;

- **Section 4: BACT Analysis** – This section presents a demonstration that the proposed air pollution control devices and measures comply with Best Available Control Technology (BACT) requirements;
- **Section 5: Air Quality Impact Evaluation –** An air quality impact evaluation was performed to demonstrate that predicted ambient air concentration impacts resulting from emissions of regulated air pollutants from the proposed plant would not adversely impact human health and welfare. These predicted impacts were determined from EPA's approved air dispersion model, referred to as AERMOD;
- **Section 6: Additional Impact Analysis -** This section provides a discussion on the additional impacts that might be caused by the proposed plant including soil and vegetation, endangered species, Class I areas, etc.;
- **Section 7: Suggested Permit Structure –** This section presents suggested permit language;
- **Section 8: Application Forms** – This section provides a list of the application forms required by MDEQ;
- **Appendix A: MDEQ Application Forms** – Appendix A includes the appropriate MDEQ application forms required for a construction permit; and
- **Appendix B**: **Air Quality Impact Evaluation Modeling Results** – Appendix B contains copies of the output files obtained from the air dispersion model "AERMOD", which was used to perform the air quality impact modeling.

Section 2: Description of Proposed Plant

MS Silicon is proposing the construction of a silicon manufacturing plant in Tishomingo County, Mississippi. The plant will consist of two (2) specific process areas:

- Silicon manufacturing; and
- Support operations.

The silicon manufacturing process will involve the mixing of quartz, coal, and wood in a semi-enclosed submerged arc furnace to produce 98% pure silicon. Further processing is performed to produce the 98% pure silicon in the form of an ingot or flake.

The silicon manufacturing process will include the following operations with the potential to emit regulated air pollutants:

- Material handling and transfer to and from coal, wood and quartz storage piles;
- Storage yard for coal, wood and quartz storage piles;
- Wind erosion from coal, wood and quartz storage piles;
- Wood chipper (electric-fired);
- Casting frames;
- Raw material day bins with supporting baghouse(s);
- Four (4) semi-enclosed submerged arc furnaces (SAF) with four (4) baghouses;
- Four (4) ladle pre-heaters; and
- Product refining operations with supporting baghouse(s).

The following plantwide operations and activities will support the entire plant and will also have the potential to emit regulated air pollutants:

- Tank farm;
- Fugitive emissions from roadways;
- Slag handling;
- Silica fume silos:
- Facility-wide miscellaneous operations; and
- Emergency generator.

To provide a visual representation of the plant, several figures are contained in this application. The figures provided are as follows:

- Figure 1-1 provides a county map of the state of Mississippi and the location on the proposed plant
- Figure 1-2 provides the proposed site location in relation to Burnsville, MS;
- Figure 1-3 provides an aerial view of the proposed plant location.

Collectively, the process areas noted above will have the potential to emit major levels of regulated air pollutants and will be subject to the PSD air regulations along with air regulations established by the Mississippi Department of Environmental Quality (MDEQ). Proven and highly efficient air pollutant emission control technologies and techniques will be utilized to minimize potential air emissions from the air emission units associated with the proposed plant. Continuous emission measuring, stack testing, as well as recording of operational parameters will also be performed, as appropriate; to confirm the plant's levels of regulated air pollutant emissions. These emissions will result in the plant having no adverse impacts to human health and welfare.

To support the conclusion that no adverse impacts will occur to human health and welfare, MS Silicon has conducted an air quality impact evaluation for potential emissions of regulated air pollutants from the plant. The results of that evaluation, including a demonstration of compliance with the state and National Ambient Air Quality Standards is included in Section 5 of this PSD construction permit application.

The general layout of the silicon manufacturing process is provided in Figure 2-1. A general process flow diagram of the silicon manufacturing process is presented in Figure 2-2 and process descriptions and definitions are provided in Figure 2-2a. A generic process flow summary of the silicon manufacturing process is provided in Figure 2-2b and representative pictures depicting the silicon manufacturing process are shown in Figure 2-2c. Process flow diagrams depicting other processes and equipment associated with the silicon manufacturing plant are provided in Figures 2-3 through 2-9.

This section contains a discussion of the process equipment, a description of the air pollution control technologies / management practices to be used, the methods used to estimate the potential emissions of regulated air pollutants, and tables summarizing the estimates of these regulated air pollutant emission rates. Tables 2-1 and 2-1a identify the initial list of equipment with the potential to emit regulated air pollutants, including stack information. Summaries of project related estimated PTE of regulated air pollutants including criteria air pollutants, hazardous air pollutants (HAPs) and greenhouse gases (GHG) are provided in Tables 2-9, 2-10 and 2-11, respectively. As shown in these tables, the proposed plant is classified as a major stationary source of regulated air pollutants as defined under state and federal air regulations.

To support the emission estimation process, methodologies involving engineering estimates, vendor suggested emission rates and prior experience were utilized to conservatively estimate PTE regulated air pollutants from the proposed silicon manufacturing plant. As part of the emission estimation process, MS Silicon utilized the best available information/data to determine air pollutant emission levels for each of the four SAFs. Emission estimates for the raw material receiving, handling and storage operations, and emergency support equipment were based on either a) USEPA established emission factors and methodologies; b) vendor estimates; or c) state/federal emission standards.

For purposes of this application, any reference to particulate matter (PM) also includes particulate matter with an aerodynamic diameter less than or equal to a nominal ten (10) micrometers (PM_{10}) and particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers ($PM_{2.5}$).

Provided below is a discussion on each process area to be performed within the silicon manufacturing process. To assist MDEQ in their development of the plant's construction permit, we have also included emission identification numbers following the numbering scheme typically employed by the MDEQ in their construction and operating permits.

2.1 Silicon Manufacturing Process – AA-100, AA-200 and AA-300

The proposed silicon manufacturing process will utilize four semi-enclosed submerged arc furnaces (SAF) that will convert raw materials including coal, woodchips and quartz to 98-99% pure silicon metal. .

The three (3) primary air pollutant emission activities within the silicon manufacturing process are 1) raw material handling and storage, 2) processing of these raw materials into one of four SAFs and supporting activities to produce silicon ingots, and 3) product refinement and handling. These three (3) activities have been assigned emission ID's AA-100, AA-200, and AA-300, respectively.

2.1.1 Raw Material Handling, Storage and Transfer to/from Storage Piles – AA-101, AA-102, AA-103, AA-104, AA-105 and AA-106

Raw material handling, transferring and storage operations will begin with the receipt of raw materials via truck. Coal, woodchips, and quartz are unloaded in a designated unloading area where various mechanisms will be used to transfer these materials to the appropriate storage piles. These mechanisms will include unloading of the trucks by tilting of the truck or bottom unloading from the truck. The raw materials will be emptied onto the pile or transferred by front end loaders to the piles. From the storage piles, materials will be conveyed via front end loaders to enclosed raw material storage/day bins. From the day bins, the raw materials will be weighed and dropped to a skip bucket from which they will be transferred to the top of one (1) of four (4) semi-enclosed submerged arc furnaces for processing. Limestone will be used as flux and will be delivered in bulk. Provision will be made for its storage in the Raw Material Enclosure area. The same hopper and conveying system will be used to convey limestone to the SAF. Limestone will be fed directly via one of the charging conveyors on the upper floor.

The following emission units have been identified in the raw materials handling, storage and transfer operations process (AA-100):

- AA-101 – Material handling and transfer to and from coal storage pile with a material throughput rate of 105,120 tons/year;

- AA-102 - Material handling and transfer to and from wood storage pile with a material throughput rate of 212,763 tons/year;
- AA-102b – Wood chipper (electric-fired);
- AA-103 - Material handling and transfer to and from quartz storage pile with a material throughput rate of 212,763 tons/year;
- AA-104 – Limestone handling operations with a material throughput rate of approximately 183 tons/year;
- AA-101a, AA-102a, AA-103a, - Material Handling (Coal, Wood, and Quartz Transfer to Day Bins) Baghouse;
- AA-105 – Storage Pile Processing (Bulldozers); and
- AA-106 – Wind erosion on coal, wood and quartz storage piles.

Refer to Figure 2-3 for a process flow diagram of the raw material handling and transfer operations.

2.1.1.1 Potential Air Pollutant Emission Sources

Since the material handling operations will involve solid type materials, potential particulate matter (PM) emissions may occur from a) unloading of raw materials from the trucks; b) moving the materials by front end loaders to the pile areas/day bins; c) conveying the material to the day bins/SAFs; d) fugitive dust from vehicle traffic on the plant roads; and e) wind erosion from the raw material storage areas. It is important to note that the conveyors and conveyor transfer drop points associated with this process area will be covered to the extent physically possible. Potential PM emissions from the covered storage area will be minimal based on the moisture content of the materials, as well as any walls and/or roof that may be used to cover the primary pile, thus minimizing the exposure of the stored materials to wind. PM emissions from the storage areas and equipment to be utilized to place and remove these materials from this storage area will also be negligible due to the use of larger sized pieces of materials, high moisture content of the raw materials and low speed of the vehicles moving the materials.

Potential fugitive dust emission rates were estimated using the recommended methods developed by USEPA (i.e., AP-42). Emission source types for this process includes material handling (i.e., material drop points), paved and unpaved road (truck traffic on the paved and unpaved roads), equipment (i.e., front end loaders) utilized to maintain the storage areas, and wind erosion from the proposed outside storage area. Details of the calculations and the resulting emission estimates can be found in Tables 2-4 through 2-7d. Appropriate control efficiencies have been incorporated to reflect equipment installed to minimize exposure to wind during the actual transfer of material from one conveyor to another or dropping of the material to a storage pile.

2.1.1.2 Air Pollution Control Devices/Technologies

The raw material receiving, handling, storage, and processing system will be designed to minimize fugitive dust emissions through use of best management practices, which include covers on conveyors and, to the extent physically possible, covered chutes for dropping materials to and from conveyors (referred to as conveyor transfer points). It is important to note that specific sections of the conveyor system will be uncovered to allow for visual inspection of the materials. Dropping raw materials onto the outdoor storage areas will also be designed to minimize excessive dust. Raw material day bins, identified as emission group AA-101a, AA-102a and AA-103a, will be used to support the semi-enclosed submerged arc furnaces. The raw materials from the storage piles will be transferred to the raw material day bins using front end loaders before being loaded into the semi-enclosed submerged arc furnaces. The transfer of raw materials to the day bins will be controlled by a common baghouse or a series of smaller baghouses. All of the above techniques represent the best available control technology for minimizing PM emissions from the raw material receiving, handling, and storage operations. The raw materials to be utilized will generally be moist, larger in size than finer materials such as sand, and not prone to dusting. The composition of the materials themselves inherently reduces the potential for PM emissions.

2.1.1.3 Type of Release (Point or Fugitive)

With the exception of the transfer to coal, wood, and quartz to the day bins, all of the PM emissions associated with the raw material receiving, handling and storage operations will be fugitive in nature.

2.1.1.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential fugitive PM emission rates were estimated using the recommended methods developed by EPA (i.e., AP-42). Emission source types for this process included material handling (i.e., conveyor transfer points or material drop points), paved road (truck traffic on these paved roads), equipment (i.e., front end loaders) utilized to maintain the storage areas, and wind erosion from the proposed outside storage areas. Details of the calculations and the resulting emission estimates can be found in Tables 2-4 through 2-7d.

2.1.2 Silicon Manufacturing Process (i.e., Meltshop Operations)

The silicon manufacturing process (i.e., the meltshop operations) will include melting, transferring and cooling operations. Refer to Figures 2-4 and 2-5 for process flow diagrams related to the furnaces and metal processing, respectively.

The raw material day bins, identified as emission group AA-101a, AA-102a and AA-103a, will be used to support the semi-enclosed submerged arc furnaces. The raw materials from the storage piles will be transferred to the raw material day bins before being loaded into the semi-enclosed submerged arc furnaces. Material will be mechanically (i.e., front end loaders or other types of equipment) moved to reclaim areas where the materials will be conveyed either underground or aboveground to the raw material day bins.

The raw material day bins will then feed into one or more of the four (4) SAFs. The SAFs will then convert the coal, woodchips, and quartz into 98% pure silicon metal in molten form. Each SAF will be rated at approximately 25 megawatts per hour of input and will produce a design maximum of 2.75 tons of silicon per hour. The processes associated with producing the silicon will include raw material handling and silicon metal melting and tapping. Each SAF will be equipped with a baghouse for controlling PM emissions. Appropriate equipment will be installed on each SAF that will be used to duct furnace exhaust gases to the baghouse.

These four (4) SAFs are identified as emission unit AA-201 and will produce 98-99% pure silicon metal. The submerged arc process is a reduction smelting operation. In the production of silicon metal, quartz is the raw material from which silicon is derived. Carbon is necessary as a reducing agent and is supplied by coal and woodchips and limestone is used as flux. Smelting in the SAF is accomplished by conversion of electric energy to heat. An alternating current applied to the electrodes causes a current to flow through the charge from the electrode tips to the furnace hearth. This provides a reaction zone of temperature up to 3600 degrees F. To maintain a uniform electric load, electrode depth is continuously varied automatically, as required. At high temperatures in the reaction zone, the carbon sources react chemically with silicon dioxide gas to form carbon monoxide and silicon metal.

Molten product from the SAFs will then be tapped from the SAF through a taphole located at the bottom of the SAF at hearth level. The molten metal and dross will flow from the taphole into a ladle. The ladle will be moved by a hoist to the casting process. The metal will be poured into low, flat pans that will provide rapid cooling of the molten metal. Fume and dust generated and captured throughout the production process including tapping will be controlled by the baghouses and then collected and reused or sold.

The process will also include four (4) natural gas-fired ladle pre-heaters rated at 10.0 MMBtu/hr each, which will be used to provide additional heat for further processing of the molten silicon to silicon flakes. The natural gas-fired ladle pre-heaters are identified as emission unit AA-202.

2.1.2.1 Potential Air Pollutant Emission Sources

Due to the nature of this operation, potential emissions of criteria air pollutants including carbon monoxide (CO), nitrogen oxide (NO_x), sulfur dioxide (SO_2), volatile organic compounds (VOC), particulate matter (PM) and greenhouse gases (primarily in the form of carbon dioxide (CO_2) may occur from a) smelting in the SAF; b) combustion of natural gas in the ladle pre-heaters; and c) material ladling and casting operations.

Fume and dust generated and captured throughout this manufacturing process including tapping will be controlled by the baghouses which vents to a single exhaust stack associated with each SAF. The collected dust from the meltshop baghouses will then be collected and reused or sold.

2.1.2.2 Air Pollution Control Devices/Technologies

Four (4) baghouses will be used to capture and control PM emissions generated from the four (4) SAF operations. Good work practices will also be employed to minimize the release of regulated air pollutants from the entire meltshop operations.

2.1.2.3 Type of Release (Point or Fugitive)

All of the emissions associated with natural gas combustion in the ladle pre-heater are considered fugitive in natural and will not be routed to a control device or through a stack.

Each of the four (4) SAFs is considered a point source and will be controlled by its own baghouse. Each baghouse will have a stack with the following parameters:

- Stack Height – Approximately 300 feet above grade;
- Stack Diameter - 15 feet in diameter;
- Stack flow rate of 125,000 acfm; and
- Exhaust stack gas temperature of approximately 140 degrees F.

2.1.2.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential PM emission rates from the SAFs were estimated using the recommended methods developed by EPA (i.e., AP-42). Emissions of other regulated criteria air pollutants were based on engineering design and estimates, recent permits issued or recent BACT determinations. Emissions of regulated criteria air pollutants from natural gas combustion in the ladle pre-heaters were also estimated using the recommended methods developed by EPA (i.e., AP-42). Details of the calculations and the resulting emission estimates for the SAFs can be found in Tables 2-2a, 2-2b and 2-2c. Emissions from natural gas combustion are found in Tables 2-3a, 2-3b and 2-3c. Potential regulated air pollutant emissions from the casting frames are presented in Table 2-2d.

2.1.3 Wood Chipping – AA-102b

A portable electric wood chipper will be used for as needed wood grinding/chipping and will be limited to 2080 hours per year of operation. Fugitive particulate emissions can occur from operation of the wood chipper (AA-102b). The wood chipper will include an enclosure that will minimize fugitive dust emissions. Refer to Figure 2-3 for a process flow diagram of the raw material handling and storage operations.

2.1.3.1 Potential Air Pollutant Emission Sources

Processing wood in the wood chipper has the potential to emit PM. Details of the calculations and the resulting emission estimates can be found in Tables 2-4b.

2.1.3.2 Air Pollution Control Devices/Technologies

The wood chipper will include an enclosure that will minimize fugitive dust emissions.

2.1.3.3 Type of Release (Point or Fugitive)

The PM emissions associated with wood chipping operations with be fugitive sources.

2.1.3.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential fugitive PM emission rates were estimated using a PM emission factor based on Idaho Department of Environmental Quality factor for similar source (wood debarking) as referenced in Idaho air permit number 4051-00. The emission estimate assumed that PM_{10} emissions are 10% of PM emissions based on North Carolina Department of Environment and Natural Resources study "Estimating Emissions from Generation and Combustion of "Waste" Wood DRAFT" (July 15, 1998), which indicated that PM_{10} generated during milling and sawing is at most 10% of PM. The estimate is also based on the assumption that $PM_{2.5}$ emissions are equal to PM_{10} emissions. Details of the calculations and the resulting emission estimates can be found in Table 2-4b.

2.1.4 Product Refinement and Handling – AA-300

Silicon product refinement and handling occurs after the casting operations. After the metal has been cooled it will be crushed and sized to customer specifications. Any remaining undersized material will be re-melted during the casting process. The following emission units have been identified in the product refinement and handling operation (AA-301):

- AA-301 –Silicon grinding and milling operations.

Refer to Figure 2-6 for a process flow diagram of the silicon product refinement and handling operations.

2.1.4.1 Potential Air Pollutant Emission Sources

Since the silicon product refinement and handling operation will involve solid type materials, potential particulate matter (PM) emissions may occur from grinding, milling and transfer of the product.

The grinding and milling operations will be equipped with either a common baghouse or series of smaller baghouses for controlling PM emissions. Details of the calculations and the resulting emission estimates can be found in Tables 2-4a.

2.1.4.2 Air Pollution Control Devices/Technologies

The grinding and milling operations will be equipped with either a common baghouse or series of smaller baghouses for controlling PM emissions.

2.1.4.3 Type of Release (Point or Fugitive)

All of the PM emissions associated with product refinement and handling operations with be point sources.

2.1.4.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential PM emission rates were estimated using the manufacturer's specifications for the baghouses and the flow rate of each control device. Details of the calculations and the resulting emission estimates can be found in Tables 2-4a.

2.2 Plantwide Operations and Activities – AA-400

The proposed silicon manufacturing plant will have additional support operations and activities including the following:

- Tank farm identified as emissions unit AA-401 including:
  - One (1) vertical oxygen storage tank with a storage capacity of 6,000 gallons; and
  - One (1) 500-gallon diesel fuel storage tank.
- Plantwide fugitive emissions from roadways identified as emissions unit AA-402 and AA-402a. Emissions represent haul trucks to support plant operations;
- Slag handling and storage identified as emission unit AA-403;
- Silica fume silos identified as emission unit AA-404; and
- Facilitywide Miscellaneous Operations Subject to APC-S-6 identified as AA-405.

2.2.1 Tank Farm – AA-401

The tank farm will include the following tanks:

- One (1) vertical oxygen storage tank with a storage capacity of 6,000 gallons; and
- One (1) 500-gallon diesel fuel storage tank.

2.2.1.1 Potential Air Pollutant Emission Sources

The oxygen storage tank does not have the potential to emit regulated air pollutants. The 500-gallon diesel storage tank has the potential to emit a regulated air pollutant (VOCs).

2.2.1.2 Air Pollution Control Devices/Technologies

All emissions of regulated air pollutants from the storage tanks will be fugitive in nature and will not include any additional control devices, other than those inherent to each tank (i.e., pressure relief valves). Good operating practices will be followed to minimize VOC emissions from the diesel storage tank.

2.2.1.3 Type of Release (Point or Fugitive)

All emissions of regulated air pollutants from the storage tanks will be will be fugitive in nature.

2.2.1.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

As per Mississippi Title V Air Permit Regulations APC–S-6 Section VII B.7 “Insignificant Activities and Emissions”, the 500- gallon diesel storage tank must be listed in the application but emissions do not have to be quantified.

2.2.2 Fugitive Emissions from Roadways – AA-402 and AA-402a

PM emissions may be generated from the use of haul trucks to support plant operations. The empty haul trucks have been assumed to weigh 22 tons and have a cargo capacity of 17 tons. The majority of the trucks to enter and leave the site will be carrying materials to support the plant as well as the silicon product produced by the plant.

2.2.2.1 Potential Air Pollutant Emission Sources

Potential emissions of regulated air pollutants from the roadways will include fugitive PM and dust from trucks on paved or unpaved roads.

2.2.2.2 Air Pollution Control Devices/Technologies

All emissions of regulated air pollutants from the roadways will be fugitive in nature and will not include any additional control devices. However, dust suppression techniques will be used to minimize the amount of dust generated from vehicles on unpaved roads. These techniques include watering the roadways and other fugitive dust control techniques such as limiting the speed of the individual trucks. Good work practices will be followed for the paved road surface which will include implementing procedures to minimize the buildup of materials on the paved roadways.

2.2.2.3 Type of Release (Point or Fugitive)

All emissions of regulated air pollutants from the roadways will be will be fugitive in nature.

2.2.2.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential emission rates of regulated air pollutants from the roadways were estimated using the recommended methods developed by EPA (i.e., AP-42). Details of the calculations and the resulting emission estimates can be found in Tables 2-6 and 2-6a.

2.2.3 Slag Handling and Storage – AA-403

PM emissions may be generated from the handling and storage of slag. Slag will be processed as needed in the finished product processing area; this process incorporates a fabric filter baghouse.

2.2.3.1 Potential Air Pollutant Emission Sources

Potential emissions of regulated air pollutants from slag handling will include fugitive PM.

2.2.3.2 Air Pollution Control Devices/Technologies

Slag will be processed as needed in the finished product processing area; this process incorporates a fabric filter baghouse.

2.2.3.3 Type of Release (Point or Fugitive)

All emissions of regulated air pollutants from the slag handling will be will be fugitive in nature.

2.2.3.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential emission rates of regulated air pollutants from the handling of slag were estimated using the recommended methods developed by EPA (i.e., AP-42). Details of the calculations and the resulting emission estimates can be found in Tables 2-4c and 2-7d.

2.2.4 Silica Fume Silos – AA-404

Silica fumes collected in the SAF baghouses will be pneumatically transferred to the silica fume silos. In the silos, the silica fumes will be densified to about 45 lbs/cu.ft., prior to dispatch to cement and refractory manufacturers.

2.2.4.1 Potential Air Pollutant Emission Sources

Potential emissions of regulated air pollutants from the silos will include PM.

2.2.4.2 Air Pollution Control Devices/Technologies

All emissions of regulated air pollutants from the silos will be fugitive in nature and will not include any additional control devices.

2.2.4.3 Type of Release (Point or Fugitive)

All emissions of regulated air pollutants from the roadways will be will be fugitive in nature.

2.2.4.4 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential emission rates of regulated air pollutants from the silos were estimated. Details of the calculations and the resulting emission estimates can be found in Table 2-4d.

2.2.5 Facilitywide Miscellaneous Operations Subject to APC-S-6 – AA-405

Several operations will be performed that will result in insignificant air contaminant emission rates and/or may not be regulated under state or federal air permitting requirements. These following activities/emissions sources are not required to be included in a Title V permit application. These sources may include:

1. New or modified pilot plants, subject to temporary source regulations located in Section III.E.

2. Maintenance and upkeep:

a. maintenance, structural changes, or repairs which do not change the capacity of such process, fuel-burning, refuse-burning, or control equipment, and do not involve any change in quality, nature, or quantity of potential emissions of any regulated air pollutants; and

b. housekeeping activities or building maintenance procedures;

3. Air conditioning or ventilation: comfort air conditioning or comfort ventilating systems which do not transport, remove, or exhaust regulated air pollutants to the atmosphere;

4. Laboratory equipment:

a. laboratory equipment used exclusively for chemical or physical analysis for quality control or environmental monitoring purposes.

5. Hot water heaters which are used for domestic purposes only and are not used to heat process water;

6. Fuel use related to food preparation by a restaurant, cafeteria, residential cooker or barbecue grill where the products are intended for human consumption;

7. Clerical activities such as operating copy machines and document printers, except operation of such units on a commercial basis;

8. Hand held equipment used for buffing, polishing, carving, cutting, drilling, machining, routing, sanding, sawing, surface grinding, or turning of ceramic art work, precision parts, leather, metals, plastics, fiber board, masonry, carbon, glass, or wood;

9. Equipment for washing or drying fabricated glass or metal products, if no VOCs are used in the process and no oil or solid fuel is burned;

10. Water cooling towers (except at nuclear power plants); water treatment systems for process cooling water or boiler feed water; and water tanks, reservoirs, or other water containers not used in direct contact with gaseous or liquid process streams containing carbon compounds, sulfur compounds, halogens or halogen compounds, cyanide compounds, inorganic acids, or acid gases;

11. Domestic sewage treatment facilities (excluding combustion or incineration equipment, land farms, storage silos for dry material, or grease trap waste handling or treatment facilities);

12. Stacks or vents to prevent escape of sewer gases through plumbing traps;

13. Vacuum cleaning systems for housekeeping, except at a source with hazardous air pollutants;

14. Alkaline/phosphate washers and associated cleaners and burners;

15. Mobile sources;

16. Livestock and poultry feedlots and associated fuel burning equipment other than incinerators;

17. Outdoor kerosene heaters;

18. Equipment used for hydraulic or hydrostatic testing;

19. Safety devices, excluding those with continuous emissions; and

20. Brazing, soldering, or welding equipment that is used intermittently or in a noncontinuous mode.

In addition, the facility may include space heaters utilizing natural or LPG gas and used exclusively for space heating, as listed in APC-S-6, VII, B:

2.3 Emergency Support Equipment – AA-501

Emergency support equipment will also support the proposed assembly plant. This equipment will consist of one (1) 670 HP emergency generator identified as AA-501. This generator will be fueled by low sulfur diesel fuel.

Air emission estimates of regulated air pollutants for the emergency generator were based on USEPA AP-42 emission factors. Hours of operation were limited to 100 per year for the generator. Tables 2-8 and 2-8a provide estimated air emissions associated with the emergency generator.

2.3.1 Potential Air Pollutant Emission Sources

Due to the combustion of diesel fuel in the emergency equipment, potential emissions of criteria air pollutants including CO, NO_x, SO_2, VOC, PM and CO_2 may occur. Minor emissions of regulated HAPs may also occur from the emergency generator.

2.3.1.1 Air Pollution Control Devices/Technologies

The emergency equipment will not have any add-on control devices or technologies. However, minimal operations and good combustion practices will be followed to minimize emissions of regulated air pollutants.

2.3.1.2 Type of Release (Point or Fugitive)

Emissions of regulated air pollutants from the emergency equipment will be a point source.

2.3.1.3 Calculation of Air Pollutant Emission Basis and Supporting Documentation

Potential emission rates of regulated air pollutants from the emergency equipment were estimated using the recommended methods developed by EPA (i.e., AP-42 program) or EPA limits defined by NSPS Subpart IIII. Details of the calculations and the resulting emission estimates can be found in Tables 2-8 and 2-8a.

Section 3: Regulatory Applicability

The proposed silicon manufacturing plant will be subject to regulations incorporated in MDEQ's Air Pollution Code (APC) for air emission sources constructed and operated in Mississippi. These rules impose permitting requirements and specific standards for air emissions. This section discusses the pertinent federal, state, and local air pollution control regulations that may be applicable to the proposed plant. These types of regulations typically include:

- Requirements to obtain a construction permit prior to commencing construction;
- Emission limitations;
- Monitoring and testing requirements; and
- Recordkeeping and reporting requirements.

This section also includes a discussion on how the proposed plant will comply with these applicable regulations.

The following sections are intended to provide the following:

- **Section 3.1. Air Quality Status -** This section identifies the current air quality status for Tishomingo County, which depending on specific air quality designation status will dictate specific air permitting requirements that must be satisfied before a construction / operating permit can be issued.

- **Section 3.2. Permitting Requirements –** This section identifies the permitting requirements required by federal and state regulations, including PSD applicability that must be satisfied prior to construction / operating permit issuance.

- **Section 3.3. State and Local Requirements -** This section identifies the state and local air pollutant regulations. Table 3-4a lists the MDEQ air regulations. Those regulations that have been deemed applicable to the plant's emission sources have been highlighted. Table 3-4b includes a summary of requirements contained in "*APC-S-1 - Section 3. Specific Criteria for Sources of Particulate Matte*r" and Table 3-4c includes a summary of requirements in "*APC-S-1 - Section 4. Specific Criteria for Sources of Sulfur Compounds*". A discussion on how MS Silicon will comply with these requirements is provided in the subsections of 3.3.

- **Section 3.4. Federal Requirements, Section 3.5. NSPS Requirements and Section 3.6. NESHAP Requirements -** These sections identify the federal air pollutant regulations and Table 3-1 summarizes the federal air pollution regulations. Included in this section are tables listing the federal air regulations, including Table 3-2a which lists the New Source Performance Standards (NSPS) and Tables 3-3a and 3-3b which list the National Emission Standards for Hazardous Air Pollutants (NESHAPs). Those regulations that have been deemed applicable to the plant's emission sources have been highlighted in the tables. A discussion on how MS Silicon will comply with these requirements is provided in the subsections of 3.4, 3.5 and 3.6. Highlighted are only those regulations that impose emission standards or limits, establish monitoring and testing requirements or enforce other relevant requirements that are intended to protect human health and welfare. Applicable requirements that identify general administrative type requirements have not been identified.

3.1 Air Quality Status

The proposed project is located in Tishomingo County, Mississippi. The current air quality status of the county is as follows:

AIR POLLUTANT	ATTAINMENT STATUS
Nitrogen Dioxides (NO_2)	Attainment
Sulfur Dioxide (SO_2)	Attainment
Particulate Matter less than 10 microns (PM_{10}) and 2.5 microns ($PM_{2.5}$)	Attainment
Carbon Monoxide (CO)	Attainment
Ozone (O_3)	Attainment
Lead (Pb)	Attainment

Since the proposed site area is classified as attainment for all regulated air pollutants, the proposed project would be governed by the regulations for attainment areas, as defined in the Mississippi rules. Attainment areas are areas defined by EPA as meeting the National Ambient Air Quality Standards (NAAQS) which were established to protect human health and welfare.

3.2 Permitting Requirements

This section identifies the permitting requirements required by state and federal regulations including PSD applicability.

3.2.1 State Requirements

APC-S-5 of the MDEQ regulations includes PSD requirements. The requirements contained in APC-S-5 have been adopted and incorporate the federal PSD requirements. The MDEQ has not created new PSD requirements nor have they modified the federal PSD requirements.

3.2.2 PSD Applicability

The PSD regulations specify that any **major** new stationary source within an air quality attainment area must undergo PSD review. A major source is defined as:

- Any stationary source (or any group of stationary sources that are located on one or more contiguous or adjacent properties, and are under common control of the same person (or persons under common control)) belonging to a single major industrial grouping and that is described in Paragraph a., b., or c. of this APC-S-5-I-A-17. For the purposes of defining “major source”, a stationary source or group of stationary sources shall be considered part of a single industrial grouping if all of the pollutant emitting activities at such source or group of sources on contiguous or adjacent properties belong to the same Major Group (i.e., all have the same two-digit code) as described in the Standard Industrial Classification Manual, 1987.

- A major stationary source of air pollutants, as defined in Section 302 of the Federal Act, that directly emits or has the potential to emit, 100 tpy or more of any air pollutant subject to regulation (including any major source of fugitive emissions of any such pollutant, as determined by rule by the Administrator). The fugitive emissions of a stationary source shall not be considered in determining whether it is a major stationary source for the purposes of Section 302(j) of the Federal Act, unless the source belongs to one of the 28 designated categories of stationary sources. A list of the 28 designated source categories is found in Table 3-5a.

If the proposed project is one the 28 designated stationary sources specified in Table 3-5a, then it is subject to a PSD threshold limit of 100 tons per year. Any stationary source which is not one of the 28 designated source categories is subject to a PSD threshold of 250 tons per year or more of a regulated air pollutant.

"Potential to emit" is defined as the maximum capacity of a stationary source to emit any air pollutant under its physical and operational design consistent with 40 CFR 52.21. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation is established in a construction permit required by the EPA approved Mississippi SIP for New Source Review (NSR) or a Title V permit. This term does not alter or affect the use of this term for any other purposes under the Federal Act, or the term “capacity factor” as used in Title IV of the Federal Act or the regulations promulgated there under.

A PSD review is triggered in certain instances when emissions associated with a new major source or emission increase resulting from a major modification are “significant”. “Significant” emission thresholds are defined in two ways. The first is in terms of emission rates (tons/year) for listed air pollutants (refer to Table 3-5b) for which significant emission rates have been established.

Significant increases in emission rates are subject to PSD review in two circumstances:

- For a new source which is major for at least one regulated attainment or non-criteria pollutant (i.e., is subject to PSD review), all pollutants for which the area is not classified as nonattainment and which are emitted in amounts equal to or greater than those specified in Table 3-6 are subject to PSD review; and
- For a modification to an existing major stationary source, if both the potential increase in emissions due to the modification itself, and the resulting new emission increase of any regulated, attainment or non-criteria pollutants are equal to or greater than the respective pollutants' significant emissions rates listed in Table 3-6, the modification is "major" and are also subject to PSD review.

The second type of "significant" emission threshold is defined as any emissions rate at a new major stationary source (or any net emissions increase associated with a modification to an existing major stationary source) that is constructed within 10 kilometers of a Class I area and which would increase the 24-hour average concentration of any regulated pollutant in that area by 1 $\mu g/m^3$ or greater. Exceedance of this threshold triggers PSD review.

PSD review consists of:

- A case-by-case Best Available Control Technology (BACT) demonstration, taking into account energy, environmental, and economic impacts as well as technical feasibility for any new source or source that is physically changed;
- An ambient air quality impact analysis to determine whether the allowable emissions from the proposed project would cause or contribute to a violation of the applicable PSD increments and National Ambient Air Quality Standards (NAAQS) (refer to Table 3-6);
- An assessment of the direct and indirect effects of the proposed project on general growth, soil, vegetation, and visibility;
- Public comment, including an opportunity for a public hearing; and
- Possibly an ambient air quality monitoring program for up to one year.

An applicant may be exempt from the ambient air quality monitoring requirements if there are existing air quality monitoring data representative of the site, or if the impacts from the project are less than the monitoring de minimis concentrations listed in Table 3-6.

Tishomingo County is designated attainment, unclassifiable, or better than the national standards for all criteria air pollutants. Based on the estimated regulated criteria air pollutant emission rates associated with the proposed silicon manufacturing plant (refer to Table 2-9), emissions of $PM/PM_{10}/PM_{2.5}$, NO_x, CO, SO_2 and VOC will exceed the PSD significant emission rate (expressed in tons/year) applicability threshold. The proposed project will be considered a major source since at least one regulated air pollutant exceeds 250 tons/year.

After a careful review of the 28 designed source categories, the proposed plant is not considered one of the 28 designated source categories. One of the listed categories is secondary metal processing, which is described as the processing of metal containing materials to recover and reuse the metal. Since MS Silicon is not proposing to use scrap or other reused metals, this category was determined not to apply to the proposed plant. Thus, the plant would be subject to a 250 tons/year PSD major source applicability threshold.

Subsequently, each of above pollutants will be subject to PSD review. The requirements associated with PSD review for emissions of PM/PM_{10}/$PM_{2.5}$, NO_x, CO, SO_2 and VOC as well as MS Silicon's compliance status with these review requirements, is provided in the following sections (4.0 through 6.0) of this application.

3.3 Applicable State Requirements

Standards and limitations for visible and particulate matter emissions, sulfur emissions, organic material emissions, carbon monoxide emissions, and nitrogen oxide emissions are also contained in the state rules and regulations. These are discussed below, along with emission standards or limitations contained in these rules that may apply to the sources associated with the proposed silicon manufacturing plant. Table 3-4a provides a list of applicable and non-applicable state air pollution regulations.

3.3.1 APC-S-1 - Air Emission Regulations for the Prevention, Abatement, and Control of Air Contaminants

3.3.1.1 Section 3 – Specific Criteria for Sources of Particulate Matter

Smoke – No person shall cause, permit, or allow the emission of smoke from a point source into the open air from any manufacturing, industrial, commercial or waste disposal process which exceeds forty (40) percent opacity subject to the exceptions provided in (b) & (c).

General Nuisances – No person shall cause, permit, or allow the emissions of particles or any contaminants in sufficient amounts or of such duration from any process as to be injurious to humans, animals, plants, or property, or to be a public nuisance, or create a condition of air pollution.

Fuel Burning – Fossil Fuel Burning - The maximum permissible emissions of ash and/or particulate matter from fossil fuel burning installations shall be limited as follows: Emissions from installations of less than 10 million BTU per hour heat input shall not exceed 0.6 pounds per million BTU per hour heat input.

Manufacturing Process – General - Except as otherwise specified, no person shall cause, permit, or allow the emission from any manufacturing process, in any one hour from any point source, particulate matter in total quantities in excess of the amount determined by the relationship

$$E = 4.1\ p^{0.67}$$

Where E is the emission rate in pounds per hour and p is the process weight input rate in tons per hour.

Sampling Ports – New Equipment - The owner or operator of any new air pollution control equipment, obtained after May 8, 1970, and vented to the atmosphere, shall have necessary sampling ports and ease of accessibility.

<u>Compliance with These Requirements</u>

The emission sources associated with the proposed plant will be constructed and operated to satisfy the requirements contained within Section 3 of APC-S-1, refer to Table 3-4b for specific requirements.

3.3.1.2 Section 4 – Specific Criteria for Sources of Sulfur Compounds

Sulfur Dioxide Emissions from Fuel Burning – The maximum discharge of sulfur oxides from any fuel burning installation in which the fuel is burned primarily to produce heat or power by indirect heat transfer shall not exceed 4.8 pounds (measured at sulfur dioxide) per million BTU heat input.

The proposed plant will be using natural gas and low sulfur fuel oil (i.e., emergency equipment only) for plant specific fuel burning operations. Use of these fuels will easily satisfy SO_2 emission limitations required in the section. Refer to Table 3-4c for specific requirements related to this section.

3.3.1.3 Section 6 – New Sources (Subsection 3 – NSPS)

This section incorporates the Federal NSPS standards. The proposed plant will be in compliance with the applicable NSPS standards. Refer to Section 3.5 of this application for a discussion on each applicable NSPS standards.

3.3.1.4 Section 9 – Stack Height Considerations

Stack Height Effect on Emission Limitations – The degree of emission limitation required of any source for control of any air pollutants shall not be affected by so much of any source's stack height that exceeds good engineering practice (GEP) or by any other dispersion technique, except as provided as exemptions or exclusions defined within the regulation itself.

3.3.2 APC-S-2 – Permit Regulations for the Construction and/or Operation of Air Emissions Equipment

3.3.2.1 I – General Requirements (Subpart D "Permitting Requirements")

Unless otherwise provided by Sections XIII and XV, or other provisions of these Regulations, any new stationary source or modification of a stationary source must have a permit to construct or multi-media permit incorporating such permit before beginning construction.

The exhaust stacks associated with the proposed plant will be in compliance with the stack height limitations contained within Section 9.

3.3.2.2 II – General Standards Applicable to All Permits (Subpart B "General Provisions")

Applicants for all permits to construct or operate, or to renew a State Permit to Operate, shall specify in their application the air emission rate for each air pollutant subject to regulations under the Federal Act that can be reasonably expected to be emitted into the air as a result of operations from the source.

Each application must be signed by the responsible official. The signature of the applicant shall constitute an agreement that the applicant assumes the responsibility for any alterations, additions or changes in operation that may be necessary to achieve and maintain compliance with all Applicable Rules and Regulations.

No permit for the construction or relocation of equipment which will cause the issuance of air contaminants shall be issued when said equipment cannot comply with buffer zone requirements as follows: All sources of air emissions must be at least 150 feet from the nearest residential or recreational area.

The proposed plant will not be located within 150 feet of a residential or recreational area.

3.3.2.3 V – Application Review

Subsection A: Standards for Approving an Application for a Permit to Construct

- The stationary source shall be designed and constructed so as to operate without causing a violation of any Applicable Rules and Regulations.
- The stationary source shall be designed and constructed so as to operate without interfering with the attainment and maintenance of State and National Ambient Air Quality Standards.
- The stationary source shall be designed and constructed so as to operate such that the emission of air toxics does not result in an ambient concentration sufficient to adversely affect human health and well-being or unreasonably and adversely affect plant or animal life beyond the stationary source boundaries. The permit board may require the applicant to provide data necessary to evaluate the impacts of air toxics, including the predicted emission rates and ambient concentrations, when it deems necessary. The construction of the stationary source shall be performed in such a manner so as to reduce fugitive dust emission from construction activities to a minimum.

Subsection D: Certification of Construction, Beginning Operation, and Application for Permit to Operate

Upon completion of construction or installation of an approved stationary source or modification, the applicant shall notify the Permit Board that construction or installation was performed in accordance with the approved plans and specifications on file with the Permit Board. A new stationary source issued a Permit to Construct cannot begin operation until certification of construction by the permittee.

Compliance with APC-S-2 Requirements

MS Silicon has made a good faith effort to submit adequate information required for the permit application review and will make timely efforts to submit any supplemental information requested by the state in the future. As show in the information provided, the identified air emission units will be in compliance with applicable state and federal air statutes. These air emission units were shown through atmospheric dispersion modeling that predicted concentrations should be below state and federal health standards.

3.3.3 APC-S-3 – Mississippi Regulations for the Prevention of Air Pollution Emergency Episodes

3.3.3.1 Section 4 – Emission Control Action Programs

Any person responsible for the operation of a source of air contaminant which emits 0.25 tons per day or more of air contaminants for which air standards have been adopted shall prepare emission control action programs, consistent with good industrial practice and safe operating procedures, for reducing the emission of air contaminants into outdoor atmosphere during periods of an air pollution alert, air pollution warning, and air pollution emergency. Emission control action programs shall be designed to reduce or eliminate emissions of air contaminants into the outdoor atmosphere in accordance with the objectives set forth in Tables 1-5 which are part of this Mississippi Regulation.

MS Silicon is aware of this requirement and the proposed plant will be in compliance with the rules and regulations stated under APC-S-3, Section 4.

3.3.4 APC-S-4 – Mississippi Ambient Air Quality Standards

Except for odor, as covered, below, the ambient air quality standards for Mississippi shall be the Primary and Secondary National Ambient Air Quality Standards as duly promulgated by the U.S. Environmental Protection Agency in (or to be printed in) 40 CFR Part 50, pursuant to the Federal Clean Air Act, as amended. All such standards promulgated by the U.S. Environmental Protection Agency as of June 22, 1988, are hereby adopted and incorporated herein by the Commission by reference as the official ambient air quality standards of the State of Mississippi and shall hereafter be enforceable as such (except that the word “Administrator” in said standards shall be replaced by the words “Executive Director” and the word “Agency” in said standards shall be replaced by the word “Department”)

There shall be no odorous substances in the ambient air concentrations sufficient to adversely and unreasonably:

1. Affect human health and well-being;

2. Interfere with the use or enjoyment of property; or

3. Affect plant or animal life.

In determining that concentrations of such substances in the ambient air are adversely and unreasonably affecting human well-being or the use or enjoyment of property, of plant or animal life, the factors to be considered by the Commission will include, without limiting the generality of the foregoing, the number of complaints or petitioners alleging that such a condition exists, the frequency of the occurrence of such substances in the ambient air as confirmed by the Department of Environmental Quality staff, and the land use of the affected area.

MS Silicon is aware of this requirement and the proposed plant will be in compliance with the rules and regulations stated under APC-S-4.

3.3.5 APC-S-5 – Mississippi Regulations for the Prevention of Significant Deterioration of Air Quality

This section incorporates the Federal PSD standards. The proposed plant will be in compliance with the applicable standards. Refer to Section 3.2.2 of this application for applicable PSD standards.

3.4 Applicable Federal Requirements

USEPA has developed regulations that are designed to control air pollution. These regulations include permitting requirements for new or modified major stationary sources located in non-attainment areas, as well as Standards of Performance for certain types of new sources.

Provided below is a summary of the federal regulatory requirements potentially triggered by the proposed silicon manufacturing plant. Other federal requirements not listed in the table below were determined to be not applicable to the proposed operations.

Summary of Potentially Applicable Federal Regulatory Requirements

Air Regulation	Applicability Determination	Compliance Status
40 CFR Part 60 – New Source Performance Standards (NSPS)		
Subpart A – General Provisions	The proposed plant is subject to this requirement because construction commenced after 1/5/1981. Applicability of the General Provisions is trigged based on the plant triggering Subparts Z and IIII.	The proposed plant will be in compliance with these Subparts

Air Regulation	Applicability Determination	Compliance Status
Subpart Z – Ferroalloy Production Facilities	The proposed semi-enclosed submerged arc furnace is subject to this requirement because the SAF will produce silicon metal and construction commenced after 10/21/1974.	The proposed SAF will be in compliance with this Subpart
Subpart OOO – Nonmetallic Mineral Processing Plants	The proposed silicon manufacturing plant is not subject to this subpart because the plant will not be crushing or grinding any nonmetallic minerals. Quartz will be used in the manufacturing process but will not be crushed prior to use in the semi-enclosed submerged arc furnace.	NA
Subpart IIII – Stationary Compression Ignition Internal Combustion Engines	The proposed diesel-fired emergency generators are subject to this subpart because they have displacement of less than 30 liters per cylinder and are 2007 model year or later.	The proposed emergency generators will be in compliance with this Subpart
40 CFR Part 63 – National Emission Standards for Hazardous Air Pollutants (NESHAPs) (MACT)		
40 CFR Part 63, Subpart A – General Provisions	The proposed plant is subject to this subpart because the plant will be considered an area source of HAP emissions. Applicability of the General Provisions is trigged based on the emergency equipment triggering Subpart ZZZZ.	The plant will be in compliance with this Subpart
Subpart ZZZZ - Stationary Reciprocating Internal Combustion Engines	The proposed emergency generators are subject to this subpart because the emergency equipment meets the definition of a reciprocating internal combustion engines (RICE). This subpart has specific requirements for specified engine types at area and major sources of HAP emissions. The proposed fire pumps will be rated below the applicability threshold under this rule.	The emergency equipment will be in compliance with this Subpart
JJJJJJ - Area Sources: Industrial, Commercial, and Institutional Boilers	This subpart applies to industrial, commercial, or institutional boilers located at an area source of HAPs. The proposed natural gas fired ladle pre-heaters and electric fired semi-enclosed submerged arc furnaces do not meet the definition of a boiler thus are not subject to this subpart.	NA
YYYYYY - Area Sources: Ferroalloys	This subpart applies to ferroalloy production facilities that manufacture silicon metal and are an area source of HAPs. The	The SAF will be in compliance with this

Air Regulation	Applicability Determination	Compliance Status
Production Facilities	proposed plant will manufacture silicon metal and is an area source of HAPs thus is subject to this subpart.	Subpart
Additional Federal Regulations		
40 CFR Part 64 – Compliance Assurance Monitoring (CAM)	The proposed plant is subject to this subpart since the plant is not subject to a MACT standard proposed after 11/15/1990.	The plant will be in compliance with this Subpart
40 CFR Part 68 – Chemical Accident Prevention Provisions	MS Silicon does not anticipate processing any chemicals that would trigger applicability of the accidental release prevention requirements.	NA
40 CFR Part 82, Subpart F – Recycling and Emissions Reduction	MS Silicon does not anticipate producing or consuming any ozone-depleting substances that would trigger applicability of the protection of stratospheric ozone requirements. MS Silicon will abide by the applicable requirements that involve replacement of ozone depleting substances in plant process equipment (i.e., air conditioners, refrigerators, chillers or freezers).	The plant will be in compliance with this Subpart

Refer to Tables 3-1, 3-2a, 3-3a and 3-3b for inclusive lists showing applicable and non-applicable federal air pollution regulations for the proposed plant.

3.5 New Source Performance Standards (NSPS)

The NSPS have been developed by USEPA for specific source categories. These standards, which are codified in the Code of Federal Regulations (CFR) under Part 60 (40 CFR 60), apply to applicable equipment covered under each source category that is constructed, reconstructed or modified after a specific baseline date. A review of the existing NSPS, as well as any NSPS being proposed, was performed to determine applicability to the proposed project. Refer to Table 3-2a for a list of the NSPS regulations.

3.5.1 40 CFR Part 60, Subpart Z – Standards of Performance for Ferroalloy Production Facilities

40 CFR Part 60, Subpart Z applies to the following affected facilities "*electric submerged arc furnaces which produce silicon metal, ferrosilicon, calcium silicon, silicomanganese zirconium, ferrochrome silicon, silvery iron, high-carbon ferrochrome, charge chrome, standard ferromanganese, silicomanganese,*

ferromanganese silicon, or calcium carbide; and dust-handling equipment". This subpart applies to any facility that commences construction or modification after October 21, 1974.

According to Subpart Z, electric submerged arc furnace means "*any furnace wherein electrical energy is converted to heat energy by transmission of current between electrodes partially submerged in the furnace charge*" and silicon metal means *"any silicon alloy containing more than 96 percent silicon by weight"*. The proposed silicon manufacturing plant will be subject to Subpart Z since it meets the definition of a ferroalloy production facility and will commence construction after October 21, 1974.

The proposed silicon manufacturing plant including the semi-enclosed submerged arc furnace will be subject to the emission limitations, testing, monitoring, reporting and recordkeeping requirements contained in this Subpart. According to this Subpart, an initial performance test should be conducted based on 60.8.

Standards for Particulate Matter

Based on 60.262 – Standard for Particulate Matter, the following limits should be met for each submerged arc furnace:

- Exit from a control device and contain PM in excess of 0.45 kg/MW-hr (0.99 lb/MW-hr) while silicon metal, ferrosilicon, calcium silicon, or silicomanganese zirconium is being produced;
- Exit from a control device and exhibit 15 percent opacity or greater;
- Exit from an electric submerged arc furnace and escape the capture system and are visible without the aid of instruments;
- Escape the capture system at the tapping station and are visible without the aid of instruments for more than 40 percent of each tapping period; and
- Dust-handling equipment should not discharge any gases which exhibit 10 percent opacity or greater.

Standards for Carbon Dioxide

According to 60.263 – Standards for Carbon Monoxide, the submerged arc furnace should not discharge any gases which contain, on a dry basis, 20 or greater volume percent of CO.

This subpart states that the owner or operator shall install, calibrate, maintain and operate a continuous monitoring system for measurements of the opacity of emissions discharged into the atmosphere from the control device and also requires the owner/operator of an electric arc furnace to maintain daily records.

Operating Requirements

Section 60.265 of this subpart also states that a continuous monitoring device should be installed to continuously record the furnace power input, and the volumetric flow rate through each separately ducted hood of the capture system.

MS Silicon is aware of the requirements contained in this subpart and will be in compliance with all of the applicable requirements. The applicable requirements of 40 CFR 60, Subpart Z are summarized in Table 3-2b.

3.5.2 40 CFR Part 60, Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines

This subpart applies to stationary compression ignition (CI) internal combustion engines (ICE) that commence construction after July 11, 2005, where the CI ICE are manufactured after April 1, 2006 (and are not fire pump engines), or manufactured after July 1, 2006 (for certified National Fire Protection Association fire pump engines).

NSPS Subpart IIII specifies emission limitations, monitoring, reporting, and recordkeeping requirements for NO_x, CO, non-methane hydrocarbons (NMHC) and PM. Applicable NSPS IIII emission standards for the emergency generator and fire water pump CI ICEs are summarized as follows:

- Owners and operators of 2007 model year and later emergency stationary CI ICE with a displacement of less than 30 liters per cylinder that are not fire pump engines must comply with the emission standards for new non-road CI engines in 40 CFR 60.4202, for all pollutants, for the same model year and maximum engine power for their 2007 model year and later emergency stationary CI ICE.

- Owners and operators of fire pump engines with a displacement of less than 30 liters per cylinder must comply with the emission standards in Table 4 to NSPS Subpart IIII, for all pollutants.

NSPS Subpart IIII also stipulates specific sulfur requirements for diesel fuels. Beginning October 1, 2007 engines that use diesel fuel must meet a sulfur content of 0.05% by weight (40 CFR 80.510(a)). As of October 1, 2010 engines with a displacement of less than 30 liters/cycle and that use a diesel fuel must meet a sulfur content of 0.0015% by weight.

MS Silicon will be utilizing a diesel fuel with a sulfur content of 0.0015% by weight or less. The emergency generator is designed to have a displacement of less than 30 liters per cylinder and will comply with the applicable requirements of NSPS Subpart IIII. The applicable requirements of 40 CFR 60, Subpart IIII are summarized in Table 3-2c.

3.5.3 40 CFR Part 60, Subpart OOO – Standards of Performance for Nonmetallic Mineral Processing Plants

Applicability of Subpart OOO applies to affected facilities in fixed or portable nonmetallic processing plants, including each crusher, grinding plant, screening operation, bucket elevator, belt conveyor, bagging operation, storage bin, and enclosed truck loading station. Nonmetallic mineral processing plant means any combination of equipment that is used to crush or grind any nonmetallic mineral at any type of plant. Nonmetallic mineral means any of the following minerals or any mixture of which the majority is any of the following minerals *"(1) Crushed and Broken Stone, including Limestone, Dolomite, Granite, Traprock, Sandstone, Quartz, Quartzite, Marl, Marble, Slate, Shale, Oil Shale, and Shell.*"

This subpart contains standards for particulate matter, monitoring of operations, test methods and procedures as well as reporting and recordkeeping requirements.

Based on the design of the proposed silicon manufacturing plant, it does not appear that the plant will be considered a nonmetallic mineral processing plant since the quartz used in the process will not be used in any crushing or grinding processes. Thus, this subpart is not applicable to the proposed plant.

3.6 Hazardous Air Pollutant Regulations

The proposed plant will have the potential to emit regulated HAPs in quantities **less than 10 tons/year as an individual HAP and 25 tons/year in aggregate**; therefore, the proposed plant is considered a minor source of HAPs.

On December 15, 1996, the USEPA promulgated the final regulations implementing Section 112(g). This section addresses new and reconstructed major sources of hazardous air pollutants (HAPs). A primary requirement of this section is that those sources apply Maximum Achievable Control Technology (MACT) for control of HAPs. Section 112(g) is intended to address those sources for which USEPA has not yet established an intended source category specific MACT standard. In this sense, Section 112(g) may be seen as the "case-by-case" MACT standard.

The proposed project will not trigger case-by-case MACT since this requirement applies to new or reconstructed major stationary sources of hazardous air pollutant emissions.

USEPA has developed National Emission Standards for Hazardous Air Pollutants (NESHAP) for numerous source categories. Refer to Tables 3-3a and 3-3b for an all-inclusive list of the NESHAP and MACT standards.

3.6.1 40 CFR Part 63, Subpart ZZZZ - National Emission Standards for Hazardous Air Pollutants: Stationary Reciprocating Internal Combustion Engines

Pursuant to 40 CFR 63.6585, the proposed silicon manufacturing plant, is subject to the NESHAP for Stationary Reciprocating Internal Combustion Engines, since it will utilize stationary internal combustion reciprocating engines (RICE). The proposed emergency generator will have an initial rating of 670 HP thus making it an affected source.

MS Silicon is aware of the requirements imposed by 40 CFR 63, Subpart ZZZZ; and selection of the final generator type and size will confirm the general requirements as they pertain to emergency generators located at area sources of HAP emissions.

The applicable requirements of 40 CFR 60, Subpart ZZZZ are summarized in Table 3-3c.

3.6.2 40 CFR Part 63, Subpart JJJJJJ – National Emission Standards for Hazardous Air Pollutants for Area Sources: Industrial, Commercial, and Institutional Boilers

40 CFR Part 63, Subpart JJJJJJ applies to all industrial, commercial, or institutional boilers that are located at, or are part of, an area source of HAPs.

According to this Subpart, boiler means "*an enclosed device using controlled flame combustion in which water is heated to recover thermal energy in the form of steam or hot water. Controlled flame combustion refers to a steady-state or near steady-state, process wherein fuel and/or oxidizer feed rates are controlled. Waste heat boilers are excluded from this definition.*"

This subpart does not apply since no boilers are being installed at the proposed plant.

3.6.3 40 CFR Part 63, Subpart YYYYYY - National Emission Standards for Hazardous Air Pollutants for Area Sources: Ferroalloy Production Facilities

This subpart applies to ferroalloys production facilities in an area source of HAP emissions. A ferroalloy production facility manufactures silicon metal, ferrosilicon, ferrotitanium using the aluminum reduction process, ferrovanadium, ferromolybdenum, calcium silicon, silicomanganese zirconium, ferrochrome silicon, silvery iron, high-carbon ferrochrome, charge chrome, standard ferromanganese, silicomanganese, ferromanganese silicon, calcium carbide or other ferroalloy products using electrometallurgical operations including electric arc furnaces (EAFs) or other reaction vessels. An electrometallurgical operation affected source is new if construction or reconstruction of the EAF or other reaction vessel commenced after September 15, 2008.

This subpart contains opacity standards along with monitoring, testing, notification, reporting and recordkeeping requirements.

The proposed silicon manufacturing plant is considered a ferroalloy production facility and will be installing four semi-enclosed submerged arc furnaces. Since the facility will be considered an area source of HAPs, the requirements of this subpart are applicable. MS Silicon is aware of the requirements contained in this subpart and will be in compliance with all of the applicable requirements. The applicable requirements of 40 CFR 60, Subpart YYYYYY are summarized in Table 3-3d.

3.7 Title V Greenhouse Gas Tailoring Rule

The greenhouse gas tailoring rule sets thresholds for the greenhouse gas (GHG) emissions that define when permits under the PSD and Title V Operating Permit programs are required for new and modified industrial facilities. If the proposed project is one the 28 designated stationary sources specified in Table 3-5a, then it is subject to a criteria pollutant PSD threshold limit of 100 tons per year. Any stationary source which is not one of the 28 designated source categories is subject to a criteria pollutant PSD threshold of 250 tons per year or more. While these thresholds are appropriate for criteria pollutants, they are not feasible for GHGs because GHGs are emitted in much higher volumes. Without the tailoring rule, the lower emissions thresholds would have automatically taken effect on January 2, 2011. EPA has phased in the CAA permitting requirements for GHGs in three steps.

3.7.1 Step 1 - January 2, 2011 – June 30, 2011

Step 1 states that the permitting requirements for GHG emissions would only be subject to those sources currently subject to PSD requirements. BACT would need to be determined for sources that have an increase in total GHG emissions of at least 75,000 tpy, on a CO_2e basis. During this time, no sources would be subject to Clean Air Act permitting requirements due solely to GHG emissions.

3.7.2 Step 2 - July 1, 2011 – June 30, 2013

In Step 2, PSD permitting requirements cover new construction projects that emit GHG emissions of at least 100,000 tpy even if they do not exceed the permitting thresholds for other pollutants. Modifications at existing facilities that cause an increase of at least 75,000 tpy of GHG emissions are also subject to the permitting requirements. During this step, operating permit requirements apply to sources based on their GHG emissions even if they would not apply based on emissions of other pollutants. Facilities that emit at least 100,000 tpy CO_2e are subject to Title V permitting requirements.

3.7.3 Step 3 - June 30, 2013

On February 24, 2012, the U.S. Environmental Protection Agency (EPA) proposed to keep greenhouse gas (GHG) permitting thresholds at current levels. This step continues to focus GHG permitting on the largest emitters by retaining the permitting thresholds that were established in Steps 1 and 2.

As show in Section 2, the potential CO_2e emissions from the proposed silicon manufacturing plant are approximately 403,000 tons/year and are above the 75,000 tons/year threshold. As a result, emissions of GHG's will be subject to PSD review, which essentially entails a BACT evaluation (refer to Section 4 of this document).

3.8 Compliance Assurance Monitoring

Pursuant to requirements concerning enhanced monitoring and compliance certification under the Clean Air Act, EPA has promulgated regulations (40 CFR 64) to implement compliance assurance monitoring (CAM) for major stationary sources of air pollution that are required to obtain operating permits under Title V of the Act. The regulations require owners or operators of such sources to conduct monitoring that satisfies particular criteria established in the rule to provide a reasonable assurance of compliance with application requirements under the Act. Monitoring focuses on emissions units that rely on pollution control device equipment to achieve compliance with applicable standards. The effective date of this rule was November 21, 2007. **Compliance with the requirements of this Part will be addressed as part of the proposed plant's Part 70 Operating Permit initial application process**.

3.9 Accidental Release Provisions

Federal chemical accidental release prevention requirements have been established in 40 CFR Part 68. These requirements cover risk management planning at facilities with more than a threshold quantity of a listed regulated substance in a single process. The rule lists 77 acutely toxic substances with threshold quantities ranging from 500 to 20,000 pounds, and also lists an additional 63 flammable gases and volatile liquids, each with a 10,000 pound threshold quantity as part of the proposed repowering project. **MS Silicon does not anticipate processing any chemicals that would trigger applicability of the accidental release prevention requirements.**

3.10 Protection of Stratospheric Ozone

The requirements for the protection of stratospheric ozone have been established in 40 CFR Part 82. These requirements were created to impose limits on the production and consumption of certain ozone-depleting substances. The purpose of 40 CFR 82 Subpart F, "Recycling and Emissions Reduction", is to reduce emissions of class I and class II refrigerants and their substitutes to the lowest achievable level by maximizing the recapture and recycling of such refrigerants during the service, maintenance, repair, and disposal of appliances. This Subpart applies to the servicing, maintaining, or repairing of appliances and also applies to the disposal of appliances.

MS Silicon may be involved in the servicing, maintaining or repairing of equipment subject to the handling and recycling provisions of this subpart. MS Silicon will follow the requirements as mandated by this subpart.

3.11 Mandatory Greenhouse Gas Reporting

40 CFR 98 established mandatory greenhouse gas (GHG) reporting requirements for owners and operators of certain facilities that directly emit GHG as well as for certain fossil fuel supplies and industrial GHG suppliers.

Included in this rule is the requirement to quantify and report GHG emissions on an annual basis. The first report was due to USEPA on March 31, 2011 for emissions released during the calendar year 2010.

MS Silicon is aware of this requirement and will evaluate its applicability and reporting requirements upon operation of the proposed plant.

Section 4: Best Available Control Technology (BACT)

4.1 Background

4.1.1 Best Available Control Technology (BACT) Evaluation Process

The following section describes the process of evaluating and defining BACT for emissions of PM_{10}, $PM_{2.5}$, NO_2, CO, SO_2 and GHG associated with the proposed silicon metal manufacturing process. Any major stationary source or major modification subject to PSD must conduct an analysis to ensure the application of best available control technology (BACT). The requirement to conduct a BACT analysis and determination is set forth in section 165(a)(4) of the Clean Air Act (Act), in federal regulations at 40 CFR 52.21(j), in regulations setting forth the requirements for State implementation plan approval of a State PSD program at 40 CFR 51.166(j), and in the SIP's of the various States at 40 CFR Part 52, Subpart A - Subpart FFF.

4.1.2 Process Description

The proposed plant will consist of a silicon manufacturing plant. The silicon manufacturing process consists of the continuous reduction of quartz (SiO_2) into silicon by a reducing mixture according to the simplified relation:

$SiO_2 + 2C \rightarrow Si + 2CO$.

As components of the mixture, carbon in the form of mineral carbon, petroleum coke, and wood-chips can be used. The electric current runs through the electrode between the contact plates and the tip of the electrode causing the ignition of the electric arc with its extremely high temperatures (> 2000°C) necessary for the reduction of quartz into silicon. The silicon is then tapped from the bottom of the submerged arc furnace.

The following emission sources will be included in this BACT analysis:

- Silicon Manufacturing Process (as defined in AP 42, Fifth Edition, Volume I, Chapter 12.4: Metallurgical Industry, Ferroalloy Production):
    - Submerged Arc Furnaces - Smelting in an electric arc furnace is accomplished by conversion of electrical energy to heat. An alternating current applied to the electrodes causes' current to flow through the charge between the electrode tips. This provides a reaction zone at temperatures up to 2000°C (3632°F). The tip of each electrode changes polarity continuously as the alternating current flows between the tips. The carbonaceous material in the furnace charge reacts with oxygen in the metal oxides of the charge and reduces them to base metals. The reactions produce large quantities of carbon monoxide (CO) that passes upward through the furnace charge. Large amounts of carbon monoxide and organic materials also are emitted by submerged electric arc furnaces. Carbon monoxide is

formed as a byproduct of the chemical reaction between oxygen in the metal oxides of the charge and carbon contained in the reducing agent (coke, coal, etc.). Reduction gases containing organic compounds and carbon monoxide continuously rise from the high-temperature reaction zone, entraining fine particles and fume precursors. The mass weight of carbon monoxide produced sometimes exceeds that of the metallic product. The heat-induced fume consists of oxides of the products being produced and carbon from the reducing agent. The fume is enriched by silicon dioxide, calcium oxide, and magnesium oxide, if present in the charge.

- Natural Gas Fired Ladle Preheaters;
- Material Handling – Receiving, Material Handling, Storage and Truck Loadout – Includes the following materials:
  - Coal;
  - Wood; and
  - Quartz.
- Product Refining;
- Fugitive Emissions from Roadways; and
- Emergency Support Equipment.

4.1.3 Definition of BACT

The BACT requirement is defined as:

> *"an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results."*

4.1.3.1 BACT Demonstration Approach

BACT by definition is the most effective control option which is technically feasible considering economic, energy, and other environmental impacts. Control options can be eliminated as BACT on a basis of technical, economic, energy, or environmental considerations. The determination of BACT follows a Top-Down approach. In the top-down approach, progressively less stringent control technologies are analyzed until a level of control considered BACT is reached on the basis of environmental, energy and economic impacts. The key steps in the Top-Down process are as follows:

STEP 1: Identify Available Control Technologies: For the source, emissions unit, activity, or process requiring BACT, identify and list all "available" emissions control options for each pollutant. Available control options are those control technologies and techniques with a practical potential for application to the source, emissions unit, activity, or process. In general, any control option in commercial use in the United States at the time the analysis is performed should be included on the list of available control options.

STEP 2: Eliminate Technically Infeasible Options: Considering site-specific factors and constraints, remove from the list compiled in STEP 1 all technically infeasible control options. A control option can be considered as technically infeasible if technical difficulties such as physical, chemical, or engineering constraints would preclude the successful use of the control option in the particular application in question. For all control options eliminated, demonstration that a control option is technically infeasible should be clearly documented in the BACT Analysis and included with the BACT submittal.

STEP 3: Rank Remaining Control Technologies by Control Effectiveness: Rank and list all remaining control options in order of control effectiveness with the most effective control alternative at the top of the list. As noted above, the control technologies to be evaluated and ranked will apply to those associated with controlling emissions from similar emission sources.

STEP 4: Energy, Environmental, and Economic Considerations: Using the "Top Down" procedure specified below, control options may be eliminated as BACT candidates on the basis of energy, environmental, and economic impacts of the option. Energy impacts include but are not limited to energy efficiency impacts, fuel cycle efficiency considerations, and fuel availability. Environmental impacts include but are not limited to ground water and water impacts, solid and hazardous waste impacts, and air quality impacts from increases in emissions of other air pollutants that result from implementing the control option. Economic impacts include the sum of up-front capital cost and annual operation and maintenance costs of implementing the control option.

A control option may be eliminated as a BACT candidate on grounds of significant energy, environmental, or economic impacts. Rationale for eliminating a control option should be well documented and included in the analysis. Economic impacts should be evaluated by comparing the cost effectiveness of the control option with generally acceptable cost effectiveness ranges for control of the particular pollutant in question.

The Top Down process is defined in Steps 4A through 4E below:

- **STEP 4.A:** Start with the most effective control option from the list compiled in STEP 3 (i.e., those associated with controlling emissions from similar emission units.
- **STEP 4.B:** Provide the information specified in items (a) through (g) below for the control option being considered.
  - **a. Control Efficiency:** Enter the percent of the pollutant removed by the control option. Control efficiency should be calculated based on the control achieved from the control option in question only.
  - **b. Potential Emissions:** Potential emissions in pounds of pollutant per hour and tons of pollutant per year should be calculated based on the maximum potential to emit rather than actual emissions. Potential emissions represent the maximum capacity of a source, emissions unit, process, or activity to emit an air pollutant under physical constraints considering air pollutant emission controls and applicable regulatory limits. Operational factors such as hours of operation or partial loading which influence emissions may be included as constraints which limit the potential to emit provided that the project proponent agrees to incorporate these constraints in enforceable regulatory compliance limits.
  - **c. Expected Emissions:** Expected emissions in tons of pollutant per year should be calculated considering expected operational considerations such as down time for maintenance, periods of partial load, capacity factors, etc.
  - **d. Annual Expected Emission Reduction:** Using the expected emission rate computed in "c" and control efficiency entered in "a", compute the expected annual emission reduction in tons per year.
  - **e. Annual Cost of Control Option:** Compute the annual cost of the control option using standard economic principles. Annual cost should include both the initial capital costs as well as operation and maintenance costs. All costs should be amortized over the expected life of the control option (default is ten years). Include in the analysis the calculations, assumptions, and economic parameters used in the calculations.
  - **f. Cost Effectiveness:** Cost effectiveness is the ratio of the annual cost computed in "e" to the annual expected emission reduction computed in "d".
  - **g. Other Considerations:** List all other media impacts (water, solid waste, etc.) and energy impacts which are associated with the control option.
- **STEP 4.C:** If there are no outstanding issues regarding energy, environmental and economic impacts the analysis is ended and this control option is proposed as BACT.
- **STEP 4.D:** In the event that the control option is determined to be inappropriate due to energy, environmental, or economic impacts, this control option is eliminated and the analysis proceeds to the next control option on the list. Rationale for elimination of a control option on grounds of significant energy, environmental or economic impacts should be well documented and included with the analysis.
- **STEP 4.E:** Go to STEP 4.B and proceed with the analysis for the next control option on the list.

STEP 5: Documentation: Include with the analysis all information, calculations, assumptions, and data used in making the BACT determination.

Since MS Silicon has selected the "Top-Level" of control or design with inherent control technique, taking into account any technical limitations, the BACT evaluation that follows does not address economic, energy and environmental impacts related to a specific control device. This follows EPA's suggested approach for performing this type of BACT evaluation.

4.2 Best Available Control Technology (BACT) Analysis - Emissions of Greenhouse Gases (GHG)

This evaluation follows the guidance developed by USEPA during 2010 under the Tailoring Rule. Under this rule, any project occurring after July 1, 2011 and having a net increase of equal to or greater than 75,000 tons/year of CO_2 on an equivalence basis triggers a BACT evaluation. As defined in USEPA's document entitled "PSD and Title V Permitting Guidance for Greenhouse Gases", dated March 2011, the BACT evaluation process is required to include five (5) steps. These steps are essentially those steps that make up the Top-Down evaluation process.

This BACT evaluation focused on the control technologies that have been demonstrated and commercially available for equipment associated with silicon production. Because of the importance of controlling GHG emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes so that emissions of GHG will be controlled to the levels specified. Technologies or concepts for controlling GHG emissions are and will continue to emerge on paper and on a trial basis. Since these technologies have not been proven to be reliable (i.e., demonstrated technologies), evaluation of these technologies are not being addressed in this BACT evaluation. MS Silicon is very reluctant to install a non-proven technology that may require significant on-site adjustments, while at the same time not meeting required GHG emission limits.

4.2.1 GHG Emission Sources Subject to Control Technology Evaluation

The following GHG emission sources are present at silicon manufacturing operations:

- Semi-Enclosed Submerged Arc Furnaces (AA-201);
- Natural Gas Combustion Equipment (AA-202); and
- Emergency Equipment (AA-501).

For a summary of the estimated GHG emission rates for the sources identified above, please refer to the following table.

GHG Emission Rates for Sources Evaluated for BACT

Equipment Description	GHG CO_2e Emission Rate (tons/year)
AA-201 - Semi-Enclosed Submerged Arc Furnaces (4 SAFs)	381,866
AA-202 - Natural Gas Combustion Equipment	20,499
AA-501 - Emergency Generator	32
TOTAL	402,397

A summary of the BACT determinations for GHG emissions is presented in Table 4-1.

4.2.2 BACT Analysis for GHG Emissions from Silicon Manufacturing

The production of ferroalloys results in emission of greenhouse gases. In ferroalloy production, raw ore, carbon materials and slag forming materials are mixed and heated to carbon sources. While CO_2 is the main greenhouse gas from ferroalloy production, recent research has shown that CH_4 and N_2O account for an equivalent greenhouse gas emission of up to 5 % of the CO_2 emissions from ferrosilicon (FeSi) and silicon-metal (Si-metal) production.[1]

The most significant greenhouse gas (GHG) emissions are related to the generation of carbon dioxide during the chemical reactions occurring in the metallurgical furnaces, where carbon is used to reduce the quartz to silicon metal. The second source of CO_2 emissions in silicon metal production comes from the use of natural gas in combustion processes. **The use of emergency equipment is limited to 100 hours per year and generates an insignificant amount of GHG and thus will not be included in this BACT analysis.**

4.2.3 BACT Analysis for GHG Emissions from Semi-Enclosed Submerged Arc Furnaces (AA-201)

Step One - Identify Available GHG Control Technologies

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for

[1] Greenhouse Gas Emissions from Ferroalloy Production. T. Lindstad, S.E. Olsen, G. Tranell, T. Færden and J. Lubetsky, 2007

controlling GHG emissions from semi-enclosed submerged arc furnaces used in silicon production operations:

1. On-line USEPA Control Technology Database;
2. State Air Quality Permits; and
3. Control Technology Vendors.

Review of the above sources did not identify information on controlling GHG emissions from the semi-enclosed submerged arc furnaces used in silicon production processes. In electric arc furnaces, electrical resistance generates the heat required: the resistance in a SAF furnace is the atmosphere, while in a submerged-arc furnace the slag or charge forms the resistance. No control options for emissions from the SAF were identified in this review.

The possible control options that will be evaluated have been divided into two (2) distinct areas; 1) energy efficiency improvement options, and 2) add-on controls. The application of methods, systems, or techniques to increase energy efficiency is a key GHG-reducing opportunity. Use of inherently lower-emitting technologies, including energy efficiency measures, represents an opportunity for GHG reductions. While energy efficiency can reduce emissions of all combustion-related emissions, it is a particularly important consideration for GHGs since the use of add-on controls to reduce GHG emissions is not as well advanced as it is for most combustion-derived pollutants.

Opportunities to further improve energy efficiency from electric arc furnaces in general are described below[2].

Control Measure	Description	Discussion
Improved Process Control	Process control can optimize operations and thereby significantly reduce electricity consumption. Control and monitoring systems for SAF are moving towards integration of real-time monitoring of process variables	This control measure is feasible and will be included in the SAF design.
Adjustable Speed Drives	As flue gas flow varies over time, adjustable speed drives offer opportunities to operate dust collection fans in a more energy efficient manner.	This control measure is feasible and will be included in the SAF design.
Transformer Efficiency—Ultra-High–Power	Ultra-high–power (UHP) transformers help to reduce energy loss and increase productivity. Location of the furnace transformers minimizing the length of the HV	This control measure is feasible and will be included in the SAF design.

[2] Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Iron and Steel Industry

Control Measure	Description	Discussion
Transformers	cables, less power losses.	
Post-Combustion of the Flue Gases	Post-combustion is a process for utilizing the chemical energy in the CO and hydrogen evolving to heat the SAF ladle or to preheat other materials 570-1,470°F (300-800°C). It reduces electrical energy requirements and increases the productivity of the SAF.	This control measure is not applicable to the silicon metal production process. There are no post combustion processes for silicon metal. This control measure will be excluded from further consideration in this BACT analysis.
Direct Current Arc Furnace	The direct current (DC) arc furnace was pioneered in Europe, and these single-electrode furnaces have recently been commercialized in North America. The DC arc furnaces use DC rather than alternating current (AC). In a DC furnace one single electrode is used, and the bottom of the vessel serves as the anode. However, compared to new AC furnaces, the savings are limited.	This technology is feas ble but the technology has been only tested on an experimental scale with poor results. Direct current arc furnaces have never been performed on a large scale for silicon metal production. This control measure will be excluded from further consideration in this BACT analysis.
Engineered Refractories	Refractories in SAF have to withstand extreme conditions such as temperatures over 2,900°F (1,600°C), oxidation, thermal shock, erosion and corrosion. Refractories can be provided by a controlled microstructure: alumina particles and mullite microballoons coated uniformly with carbon and carbides.	This control measure is feasible and will be included in the SAF design.
Airtight Operation	A large amount of air enters the SAF: around 1,000,000 ft^3 (30,000 m^3) in a standard SAF. This air is at ambient temperature, and the air's nitrogen and non-reactive oxygen are heated in the furnace and exit losses. The potential benefit for an industrial furnace with an airtight process including a post combustion practice and an efficient fume exhaust control are about 100 kWh/ton for an industrial furnace having a current electric consumption of 450 kWh/ton.	The furnace is semi-closed. In order to charge the furnace with the raw materials and place them in the proper position, the furnace doors will need to be open in order to "push the raw materials" using the "stoking machine" into place. Doors will be closed when not needed.
Flue Gas Monitoring and Control	The use of VSDs can reduce energy usage of the flue gas fans, which in turn reduces the losses in the flue gas.	This control measure is feasible and will be included in the SAF design.

Control Measure	Description	Discussion
Bottom Tapping	Bottom tapping leads to slag-free tapping, shorter tap-to-tap times, reduced refractory and electrode consumption, and improved ladle life	This control measure is feasible and will be included in the SAF design.
Carbon Capture and Storage	Carbon capture and storage involves separation and capture of CO_2 from the flue gas, pressurization of the captured CO_2, transportation of the CO_2 via pipeline, and finally injection and long-term geologic storage of the captured CO_2. Several different technologies, at varying stages of development, have the potential to separate and capture CO_2. Some have been demonstrated at the slip-stream or pilot-scale, while many others are still at the bench-top or laboratory stage of development	See below.

Step Two – Eliminate Technically Infeasible Control Options

All of the control options identified under Step 1 with the exception of Direct Current Arc Furnace, Post-Combustion of the Flue Gases, and Carbon Capture and Storage are technically feasible and will be included in this BACT evaluation.

Carbon capture and sequestration (CCS) has not been applied to SAFs in the past and has not been demonstrated in practice for these emission types. CCS is generally used for facilities with sources emitting CO_2 in large amounts, such as fossil fuel-fired power plants, and for industrial facilities with high-purity CO_2 streams.

CCS involves capturing CO_2, transporting it as necessary, and permanently storing it instead of releasing it into the atmosphere. The process involves three main steps:

- Capturing CO_2 at its source by separating it from other gases produced by an industrial process. Once CO_2 is separated and captured, it then can be compressed under high pressure for transport to an appropriate geological storage site;
- Transporting the captured CO_2 to a suitable storage location (typically in compressed form); and
- Storing the CO_2 away from the atmosphere for a long period of time, for instance in underground geological formations, in the deep ocean, or within certain mineral formations.

The process of transporting CO_2 is typically considered via pipeline and has substantial associated logistic hurdles and operational penalties. Transportation infrastructure issues include pipeline routing, acquisition of rights-of-way, and associated environmental impacts. In addition, additional energy must be expended to compress and transport the compressed CO_2. An alternative means of transporting the compressed CO_2 is via a ship, similar to transporting liquid natural gas. Again, there are similar logistic hurdles and operational penalties for transporting compressed CO_2 via ship that can be substantial.

Carbon sequestration usually involves the injection of CO_2 into deep geological formations of porous rock that are capped by one or more nonporous layers of rock. Injected at high pressure, the CO_2 exists as a liquid that flows through the porous rock to fill the voids. Saline formations, exhausted oil and gas fields, and unmineable coal seams are candidates for CO_2 storage. Also, CO_2 injected for enhanced oil recovery projects can result in long-term sequestration depending on the geologic conditions. Other schemes include liquid storage in the ocean, solid storage by reactions leading to the creation of carbonates, and terrestrial sequestration. This type of infrastructure does not exist at the proposed plant site.

Another important technical consideration is that carbon capture is simpler when CO_2 is produced in high purity and high concentration streams as the byproduct of certain industrial processes, such as natural gas processing, hydrogen production, and synthetic fuel production. In contrast, it is relatively more difficult to capture CO_2 from flue gas emissions, which may require the reengineering of certain established and reliable production techniques. Apart from the technical issues of cleaning such dirty gas streams so they are suitable for CCS, unlike power plants, where CO_2 concentrations are comparatively high and consistent, metallurgical operations have more dilute concentrations of CO_2, the off gas is dirty and difficult to handle, and CO_2 production varies widely depending on the process step.

In summary, CCS is excluded from this BACT evaluation for the following reasons:

- Installation and operate of CCS is not commercially available and has not been installed in conjunction with any SAF process installed and currently operating worldwide;
- Currently there is no infrastructure available at the project site that will allow MS Silicon the ability to capture it's CO_2 gas streams and pipe them to a nearby facility for further processing, such as a beverage plant;
- Currently there is no infrastructure available at the project site that will MS Silicon the ability to capture and store it's CO_2 gas stream for future use in the event a beverage plant would be installed in the vicinity of the proposed plant site;
- CO_2 produced at the proposed plant will require significant enhancements to improve its quality prior to being used by another source to produce a product; and
- Cost estimates are not being provided in support of removing CCS as a cost effective control alternative since EPA has not provided any guidance or established thresholds on what cost, expressed as a dollar per ton would be considered cost excessive.

Because of the various reasons provided above, MS Silicon is eliminating CCS has a viable control option for GHG control based on its 1) not being commercially available and 2) not being shown to be a proven control option that has been demonstrated in actual operation.

Based on the above technical issues, CCS is consequently deemed not technically feasible for controlling GHG emissions from the proposed SAFs.

Step Three – Assessment of Proposed BACT Emission Reduction Options

This step of the Top-Down analysis provides an assessment of the performance and feasibility of the emission reduction options evaluated. MS Silicon is proposing to utilize the newest generation of submerged arc furnace with inherently lower-emitting technologies, including energy efficiency measures. This new generation furnace is designed to more efficiently convert raw materials to the silicon intermediate product. It is almost impossible to evaluate each option defined above and establish a CO_2 percent reduction.

For purposes of this GHG BACT evaluation, MS Silicon has concluded that the new generation furnace is the most effective control at reducing GHG emissions.

Step - Four Evaluate Most Effective Control and Document Results

As discussed above, various emission reduction options (i.e., new generation furnace) are being proposed by MS Silicon that are considered the **Top Level** of emission reduction available for controlling GHG emissions from the production of silicon. Since MS Silicon has selected the "Top-Level" of control or design with inherent control technique, taking into account any technical limitations, the BACT evaluation that follows does not address economic, energy and environmental impacts related to a specific control device. This follows EPA's suggested approach for performing this type of BACT evaluation.

Step Five – Select BACT

A detailed review was conducted to determine the emission reduction options incorporated at other submerged arc furnaces. Review of recently permitted GHG sources and the RBLC database did not reveal BACT determinations for submerged arc furnaces.

BACT for GHG emissions from the semi-enclosed submerged arc furnace has been determined to be:

- **Utilization of a new generation furnace with inherently lower-emitting technologies and energy efficiency measures (i.e., semi-enclosed SAF);**
- **CO_2e emission limitation of 381,866 tons/year; and**
- **Good operation and maintenance to improve energy efficiency.**

4.2.4 BACT Analysis for GHG Emissions from Natural Gas Combustion (AA-202)

The following natural gas combustion emission sources are included in this review:

Description	Heat Input (MMBTU/hr)	Heat Input (MMscf/year)	Total GHG Emissions (CO_2e) (tons/year)
Natural Gas fired Ladle Pre-Heaters – 4 Units – 10.0 MMBtu/hr each	40.0	350,00	20,499

Step One – Identify Available GHG Control Technologies

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling GHG emissions from natural gas combustion equipment:

1. On-line USEPA Control Technology Database;
2. State Air Quality Permits; and
3. Control Technology Vendors.

The application of methods, systems, or techniques to increase energy efficiency is a key GHG-reducing opportunity from combustion sources. Use of inherently lower-emitting technologies, including energy efficiency measures, represents an opportunity for GHG reductions. Since GHG are the direct result of fuel combustion, any improvement in the efficiency of a process heater will reduce fuel use and GHG emissions. While energy efficiency can reduce emissions of all combustion-related emissions, it is a particularly important consideration for GHGs since the use of add-on controls to reduce GHG emissions is not as well advanced as it is for most combustion-derived pollutants.

Approaches for reducing GHG emissions from fossil fuel-fired equipment could include fuel switching or energy efficiency measures. In the case of natural gas-fired equipment, however, fuel switching to a lower carbon fuel is not an option because natural gas emits less CO_2 per amount of heat derived than other gaseous or liquid fuels commonly used.

Summary of Potentially Applicable GHG Energy Efficiency Measures – Natural Gas Combustion Sources

Control	Removal Effectiveness	Comments
Burner replacement	Replacing old burners with more efficient modern burners can lead to significant energy savings. Energy and cost savings vary widely based on the condition and efficiency of the burners being replaced.	• Energy efficient burners will be installed in the natural gas combustion equipment

Control	Removal Effectiveness	Comments
Boiler process control	Using a combination of CO and oxygen readings, it is possible to optimize the fuel/air mixture for high flame temperature (and thus the best energy efficiency) and lower air pollutant emissions	• Natural gas combustion equipment will optimize the fuel/air mixture for high flame temperature
Reduction of flue gas quantities	Excessive flue gas results from leaks in the boiler and/or in the flue. These leaks can reduce the heat transferred to the steam and increase pumping requirements. However, such leaks are often easily repaired, saving 2 to 5 percent of the energy formerly used by the boiler	• Equipment will be maintained to minimize any leaks
Reduction of excess air	Boilers must be fired with excess air to ensure complete combustion and to reduce the presence of CO in the unburned fuel in exhaust gases. When too much excess air is used to burn fuel, energy is wasted because excessive heat is transferred to the air rather than to the steam.	• Equipment will be maintained to ensure complete combustion
Carbon Capture and Storage	Carbon capture and storage involves separation and capture of CO_2 from the flue gas, pressurization of the captured CO_2, transportation of the CO_2 via pipeline, and finally injection and long-term geologic storage of the captured CO_2. Several different technologies, at varying stages of development, have the potential to separate and capture CO_2. Some have been demonstrated at the slip-stream or pilot-scale, while many others are still at the bench-top or laboratory stage of development	See below.

Step Two – Eliminate Technically Infeasible Control Options

With the exception of carbon capture and sequestration (CCS), all of the control options identified under Step 1 are technically feasible and will be included in this BACT evaluation. CCS was not evaluated in this BACT evaluation. This type of control technology has not been applied to natural gas combustion sources in the past and has not been demonstrated in practice for these emission types. CCS is generally used for facilities with sources emitting CO_2 in large amounts, such as fossil fuel-fired power plants, and for industrial facilities with high-purity CO_2 streams. Based on this, CCS is consequently deemed not technically feasible for controlling the GHG emissions from the natural gas combustion sources that will support the proposed plant operations.

Thus, the available control options are as follows:

- Combustion of clean-burning fuel - Burners are designed to combust natural gas. Fuel switching to a lower carbon fuel is not an option because natural gas emits less CO_2 per amount of heat derived than other gaseous or liquid fuels commonly used;
- Energy efficiency pollution prevention options that are available for this type of combustion device include the following:
    - Burner efficiency;
    - Preventive Maintenance; and
    - Energy monitoring and management systems.

Step Three – Assessment of Proposed BACT Emission Reduction Options

This step of the Top-Down analysis provides an assessment of the performance and feasibility of the emission reduction options evaluated. Combustion of natural gas, low NO_x burners and good combustion practices and maintenance to improve energy efficiency are considered the top level of emission reduction available for the natural gas combustion equipment.

Step Four - Evaluate Most Effective Control and Document Results

The emission reduction options that are being proposed by MS Silicon that are considered the **Top Level** of emission reduction available for controlling GHG emissions from the combustion of natural gas. Since MS Silicon has selected the “Top-Level” of control or design with inherent control technique, taking into account any technical limitations, the BACT evaluation that follows does not address economic, energy and environmental impacts related to a specific control device. This follows EPA’s suggested approach for performing this type of BACT evaluation.

Step Five - Select BACT

A detailed review was conducted to determine the emission reduction options incorporated at other natural gas fired burners. Review of the RACT/BACT/LAER Clearinghouse (RBLC) revealed the following BACT determinations for natural gas combustion equipment.

Facility/ RBLC ID	Permit Date	Basis	Process	GHG BACT Limit	Controls
Cargill, Inc. NE-0054 DRAFT DETERMINATION	3/1/13	BACT-PSD	300 MMBtu/hr Boiler	No Limit	Good combustion practice
Iowa Fertilizer Company IA-0105	10/26/12	BACT-PSD	472.4 MMBtu/hr Auxiliary Boiler	CO_2:117 lb/MMBtu Methane:0.0023 b/MMBtu N_2O: 0.0006 b/MMBtu	Good combustion practice
Iowa Fertilizer Company IA-0105	10/26/12	BACT-PSD	110.12 MMBtu/hr Startup Heater	CO_2:117 lb/MMBtu Methane:0.0023 b/MMBtu N_2O: 0.0006 b/MMBtu	Good combustion practice
Showa Denko Carbon, Inc. SC-0142	6/8/12	BACT-PSD	5 MMBtu natural gas fired hot oil heater	CO_2e: 3093 tpy	Good combustion practice, annual tune-up low NO_x burner
Port Dolphin Energy LLC FL-0330	12/1/11	BACT-PSD	Four 278 MMBtu/hr boilers	CO_2:117 lb/MMBtu	tuning, optimization, instrumentation and controls, insulation, and turbulent flow
Pyramax Ceramics, LLC GA-0147	2/8/12	BACT-PSD	9.8 MMBtu/hr natural gas fired boiler	CO_2e: 5809 tpy rolling average	Good Combustion Practices, design, and thermal insulation
Entergy Louisiana LLC, Nine Mile Point Electric Generating Plant LA-0254	08/16/11	BACT-PSD	Auxiliary Boiler 338 MMBtu/hr	CO_2:117 lb/MMBtu Methane:0.0022 b/MMBtu N_2O: 0.0002 b/MMBtu	Proper operation and good combustion practices

Summary of Potentially Applicable GHG Energy Efficiency Measures – Natural Gas Combustion Equipment

Control	Description	Comments
Use of Low Carbon Fuels	Burners will be combusting natural gas	• Burners are designed to combust natural gas. Fuel switching to a lower carbon fuel is not an option because natural gas emits less CO_2 per amount of heat derived than other gaseous or liquid fuels

Control	Description	Comments
Energy efficient processes and technologies	• Low NOx burners, • Good combustion practices to improve energy efficiency • Good maintenance of combustion equipment	• Burner design will incorporate low NOx burners and good combustion practices and maintenance to improve energy efficiency

Based on information reviewed for this BACT analysis, the GHG control measures focus on fuel type or energy efficiency measures. No other applicable GHG control measures were identified in this review. Provided below is a summary of the emission reduction options being incorporated into the natural gas fired combustion devices associated with the proposed silicon plant. Rationale for selection of BACT includes the use of natural gas as a clean burning fuel, use of low NO_x energy efficient burner technology and good combustion practice.

BACT for this emission unit is as follows:

- CO_2 – 117 lb/MMBtu
- Methane – 0.0022 lb/MMBtu
- N_2O – 0.0002 lb/MMBtu

Control techniques to be implemented to meet these emission limitations will be: 1) good combustion practices, 2) combustion of natural gas only, 3) selection of the most energy efficient burner design based on engineering selection process and 4) periodic maintenance.

4.3 Best Available Control Technology (BACT) Analysis - Emissions of PM_{10}/$PM_{2.5}$

Particulate matter," also known as particle pollution or PM, is a complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. Particulate matter exists in the solid and liquid physical states, and gases or vapors may also condense to form particulate matter. The latter, condensable particulate matter, is of great concern due to the inherently small size of condensation products; overwhelmingly, condensable particulate can be classified as $PM_{2.5}$[3]. $PM_{2.5}$ is defined as particulate matter that has a diameter of 2.5 microns or less and is a subset of PM_{10} which is particulate with a size range of 10 microns or less. Even though both are particulate matter they have separate air quality standards and are considered separate pollutants for permitting purposes. The size of particles is directly linked to their potential for causing health problems. EPA is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. EPA groups particle pollution into two categories:

- "Inhalable coarse particles," such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter.
- "Fine particles," such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air.[4]

The BACT evaluation focuses on the control technologies that have been demonstrated and commercially available for the proposed silicon production plant. Because of the importance of controlling these emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes so that emissions of PM_{10}/$PM_{2.5}$ will be controlled to the levels specified. Condensable $PM_{2.5}$ emissions occur when gas molecules are present in the exhaust gas stream that when cooled change into a particulate state. This change from gas vapor to solid is referred to as condensable particulates. USEPA is involved in extensive research on trying to better define this change over, as well as how best to quantify the presence of these condensable particulates. For purposes of this evaluation, since no specific technologies exist (i.e., commercially available and demonstrated), above and beyond that already selected in the form of a baghouse, for controlling $PM_{2.5}$ emissions, additional emphasize was

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[3] Condensable Particulate Matter, Regulatory History and Proposed Policy, January 27, 1998 http://www.ncair.org/enf/sourcetest/cpm/condensweb.pdf

[4] http://www.epa.gov/air/particlepollution/

placed on the availability of controls to reduce emissions of SO_2 and NO_x. Emissions of SO_2 and NO_x can be present in the gas phase that could convert to solids in the form of sulfates and nitrates. USEPA has identified SO_2 and NO_x as potential precursors to the formation of $PM_{2.5}$ emissions. However, USEPA has not provided, as of the date of this application, guidance on the effect of SO_2 and NO_x as potential precursors to the formation of $PM_{2.5}$ emissions. Subsequently, evaluation of the control options to reduce SO_2 and NO_x emissions to further reduce $PM_{2.5}$ emissions have not been included in this BACT evaluation.

4.3.1 PM_{10}/$PM_{2.5}$ Emission Sources Subject to Control Technology Evaluation

The PM_{10}/$PM_{2.5}$ emission sources associated with the proposed plant that are included in this PM_{10}/$PM_{2.5}$ BACT evaluation are as follows:

- Semi-Enclosed Submerged Arc Furnaces (SAFs) (AA-201);
- Casting Frames (AA-201a);
- Silica Fume Silos (AA-404);
- Natural Gas Fired Combustion Equipment (AA-202);
- Diesel Fired Emergency Generator (AA-501);
- Material storage and handling (AA-101, AA-101a, AA-102, AA-102a, AA-103, AA-103a, AA-104, AA-105, AA-106);
- Wood Chipper (AA-102b); and
- Roadways (AA-401, AA-402a).

For a summary of the estimated PM_{10}/$PM_{2.5}$ emission rates for the sources identified above, please refer to the following table:

PM_{10}/$PM_{2.5}$Emission Rates for Sources Evaluated for BACT

Equipment Description	PM_{10} Emission Rate (tons/year)	$PM_{2.5}$ Emission Rate (tons/year)
AA-201 - Semi-Enclosed Submerged Arc Furnaces (SAFs)	61.2	61.2
AA-201a- Casting Frames	0.3	0.3
AA-202 - Natural Gas Fired Ladle Preheaters	0.1	0.1
Diesel Fired Emergency Generator (AA-501)	0.001	0.001

Equipment Description	PM_{10} Emission Rate (tons/year)	$PM_{2.5}$ Emission Rate (tons/year)
Material Handling and Storage:		
• Material Transfer to and from Coal Storage Pile (AA-101)	0.01	0.002
• Material Transfer to and from Wood Storage Pile (AA-102)	0.002	0.0003
• Material Transfer to and from Quartz Storage Pile (AA-103)	1.8	0.3
• Limestone Material Handling (AA-104)	0.0008	0.0001
• Material Handling Area Baghouse (AA-101a, AA-102a, AA-103a)	6.8	6.8
• Product Handling Area Baghouse (AA-301)	3.4	3.4
• Storage Piles Processing (i.e., Bulldozing) (AA-105)	1.7	0.2
• Storage Piles Wind Erosion (AA-106, AA-403)	2.5	0.4
• Silica Fume Silos (AA-404)	0.15	0.15
AA-102b - Wood Chipper	0.042	0.042
AA-402 - In-Plant Gravel Roads	3.7	0.37
AA-402a - In-Plant Paved Roads	0.3	0.3
Total	**81.8**	**73.3**

4.3.2 BACT Analysis for PM_{10}/$PM_{2.5}$ Emissions from Semi-Enclosed Submerged Arc Furnaces

Step One - Identify Available PM_{10}/$PM_{2.5}$ Control Technologies

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling PM_{10}/$PM_{2.5}$ emissions from plant operations:

1. On-line USEPA Control Technology Database; and
2. State Air Quality Permits;

Particulate control technologies exist today that are proven and reliable that that provide a high level of removal efficiency (i.e., in excess of 99%). These technologies are well suited for controlling particulate matter, including $PM_{2.5}$ in the form of solids or “filterable” particulates. As will be described in the BACT evaluation that follows, MS Silicon is installing a fabric filter bag-house which is considered the top level of PM_{10}/$PM_{2.5}$ control technology for filterable particulates from the semi-enclosed submerged arc furnace. MS Silicon will also be using Best Management Practices to minimize the generation of PM_{10}/$PM_{2\ 5}$ fugitive emissions.

Technologies will continue to emerge for controlling particulate matter emissions, including $PM_{2.5}$ that are in the vapor phase in the exhaust gas and when cooled by ambient air at the point of the exhaust stack release, change from a vapor phase to a solid phase. This change over is defined as “condensable” particulates. As part of the BACT evaluation that follows we have examined proven technologies that can further reduce these precursors, thus reducing the condensable portion of $PM_{2.5}$ from the exhaust gas stream. Condensable $PM_{2.5}$ emissions should be minimal from the fugitive sources.

The choice of which technology is most appropriate for a specific application depends upon several factors, including particle size to be collected, particle loading, stack gas flow rate, stack gas physical characteristics (e.g., temperature, moisture content, presence of reactive materials), and desired collection efficiency. Emissions of particulate matter are generally controlled with add-on control equipment designed to capture the emissions prior to the time they are exhausted to the atmosphere. In cases where the material being emitted is organic, particulate matter may be controlled through a combustion process. The following control technologies were identified and evaluated to control PM_{10}/$PM_{2\ 5}$ emissions from the SAF:

(a) Electrostatic Precipitator (ESP) - In an ESP, particles are electrically charged and then exposed to an electric field in which they are attracted to an electrode. Periodically, this electrode is cleaned through vibration and the freed particles are directed into a collection unit. While ESPs have been used on solid fuel combustion devices they have not been used on similar sources as the proposed plant

(b) High Efficiency Cyclones - Cyclones and multicyclones are a commonly used PM control technology in the United States. A cyclone removes particles based the principle of gravity and centrifugal force. A multicyclone uses the same concept as a cyclone but employs multiple, smaller diameter cyclones to improve its capturing capacity. The particle control efficiency of both devices decreases as the particle size decreases and therefore do not adequately control $PM_{2.5}$.

(c) High Energy Scrubbers – High energy scrubbers are a wet scrubbing system that combines a high energy venturi scrubber with a cyclonic separator. These scrubbers are effective in the removal of dusts, fumes, vapors, and mists; as well as a variety of other air pollutants, and

(d) Fabric Filters (i.e., baghouses) - Fabric filters have been widely used for controlling PM emissions from many different types of sources. Large industrial, commercial, and Institutional (ICI) boilers are equipped with these devices and have PM control efficiencies of 99 percent or higher. A fabric filter, or baghouse, is made up of cloth or woven specialty fibers. The flue gases are directed through the filter. The separation efficiency of bag filters is quite high. Because of their design (large surface area of bags and longer residence times in transit), fabric filters may capture a higher fraction of ultrafine particles than ESPs

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing PM_{10}/$PM_{2.5}$ emissions from the SAF operations. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) ESPs - use an electrostatic field to charge particulate matter contained in the gas stream and then attract and collect the particles on a collection surface of opposite charge. ESPs have very high removal efficiencies (99% or better) for many sources of particulates. However, they are not suitable for all types of applications. Due to the electromagnetic properties of small charged particles of metal compounds in an electric field, the particles adhere very strongly to the collection plates of an ESP and are extremely difficult to dislodge, resulting in ineffectivity of the ESP. Therefore, ESP is considered technically infeasible for controlling particulate emissions from the SAF.

(b) High Efficiency Cyclones - Particulate removal in cyclone collectors is achieved through the action of inertial forces, especially centrifugal. As the gas stream enters the top of the cyclone, a vortex is induced as it is forced to travel a circular path. Centrifugal forces cause the heavier particles to concentrate near the outer wall of the cyclone and particle of lesser mass to remain closer to the center of the vortex. Frictional and gravitational forces then act on the particles closest to the wall, causing them to fall toward the bottom of the cyclone, where they are collected in a hopper. Within the lower segment of the cyclone, the direction of the gas-flow vortex is reversed, and an inner ascending vortex is formed. The inner vortex consists of comparatively particulate-free air, which is collected through an outlet duct at the top of the cyclone. Cyclone collectors are considered technically feasible. However, they achieve the lowest particulate removal efficiencies (less than 90%) of all particulate control devices, especially for submicron particulates that will be emitted from the SAF.

(c) High Energy Scrubbers - High energy wet scrubbers are technically feasible and can achieve a high particulate collection efficiency (90% or better), but at the expense of a punitive pressure drop (ranging from 6 - 20 inches of water), higher operational utilities, generation of large quantities of sludge along with the associated problem of sludge handling, de-watering, and disposal.

(d) Fabric filters or baghouses are technically feasible for collecting fine particulate matter emissions associated with SAFs or other types of furnaces that have high particulate emissions. They can also achieve the highest control efficiency, among other particulate control devices, as applied to SAF operations.

(i) Positive pressure baghouses operate at internal pressures greater than the atmospheric pressure. Typically, the fans are located before the fabric filters. This allows the fans to pull air from the SAF and push the dust laden air through the fabric filters and into the ambient air via a continuous ridge vent (old design) rather than a stack. The discharge area of a ridge vent is on the order of four times that of a single stack.

(ii) Negative pressure baghouses operate at internal pressure less than atmospheric. The fans are located after the fabric filters. This allows the fans to pull the gas laden air from the SAF, through the fabric filters, and then push the air up through a central stack.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

The following remaining control options are in order of descending control effectiveness:

(a) Fabric filters or baghouses - 99.9%;

(b) High Energy Scrubbers - 90% or more; or

(c) High Efficiency Cyclones - 50 to 90%.

Step 4 – Evaluate the Most Effective Controls and Document Results

Fabric filtration is the predominant control option for abatement of particulate emissions from SAF operations application due to their effectiveness. Scrubbers and cyclones are not considered as effective as fabric filters or baghouses for controlling particulate emissions from silicon production operations.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for submerged arc furnaces or any other sources associated with the silicon production operations. Review of state permit information identified the following with respect to electric arc furnaces at silicon production plants:

Facility/	Permit Date	Process	PM_{10} Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009	11/26/10	Two submerged-arc semi-enclosed-type electric furnaces (22 MW/hr)	PM: 21.3 lb/hr per furnace (based on process weight rate calculation	Fabric filter (baghouse)

Facility/	Permit Date	Process	PM_{10} Limit	Add-On Controls
Globe Metallurgical Selma, AL 104-0001	9/10/10	20 MW Electric Arc Furnaces (2) producing silicon metal	0.99 lb/MW-hr 6.2 lb/hr	Baghouse
West Virginia Alloy, Inc. Alloy, West Virginia R30-01900001-2006	01/18/06	Electric submerged arc furnace No. 15 for the production of silicon metal and ferroalloys	PM10: 22.71 lb/hr	Baghouse with >99% control
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105	10/24/01	Electric Arc Furnaces (Ferrosilicon and Silicon metal production furnaces)	0.03 gr/dscf (filterable) or no vis ble particulate emissions, whichever is less stringent	Open roof Baghouse

As shown in the above table, PM emissions from submerged electric arc furnaces are controlled exclusively by baghouses and the BACT emission limits vary in how they are expressed. Because of the variations in the plant operations, it is very difficult to identify a consistent BACT emission limitation or permit limitation. For the $PM_{10}/PM_{2.5}$ emission sources associated with the SAFs at the proposed plant, a baghouse was the only control methods evaluated. The proposed BACT limit is at least as stringent as the permit limits presented in the table above.

Thus, BACT for $PM_{10}/PM_{2.5}$ emissions from the semi-enclosed submerged arc furnaces at the proposed plant is as follows:

- **Use of fabric filter control (i.e., baghouse); and**
- **$PM_{10}/PM_{2.5}$ – 0.005 grains per dry standard cubic foot (gr/dscf).**

4.3.3 BACT Analysis for $PM_{10}/PM_{2.5}$ Emissions from Casting Frames (AA-201a)

Molten product from the SAFs will be poured into low, flat pans that will provide rapid cooling and solidification of the molten metal. There is a potential for fume and dust to be generated during the casting process, however the amount of actual dust should be minimal.

Step One - Identify Available PM/PM_{10}/$PM_{2.5}$ Control Technologies

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. Potential PM control technologies are identified in the previous section.

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing PM/PM_{10}/$PM_{2.5}$ emissions from the casting operations. The exhausting of casting emissions from a central canopy positioned over the casting installations to the SAF baghouse is neither practical nor economically feasible since it is too far away. In addition, the casting frame emissions in question are very low (< 1.0 tons/year) and can also be further minimized by the manner with which the unit is operated. The potential PM emissions are small and installation of a canopy and exhaust dust system is not very effective at capturing these small quantities of PM emissions. Thus, add-on controls are eliminated from further consideration in this BACT evaluation.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

The following remaining control option is best management practices.

Step 4 – Evaluate the Most Effective Controls and Document Results

Best management practices are the only effective control for this type of emission source.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for casting operations associated with the silicon production operations. Review of state permit information also did not identify BACT determinations for casting operations associated with the silicon production operations.

MS Silicon will be using Best Management Practices to minimize the generation of PM/PM_{10}/$PM_{2.5}$ fugitive emissions from the casting frame operation.

BACT for PM/PM_{10}/$PM_{2.5}$ for the casting frames (AA-201a) is proposed as:

- Best Management Practices to minimize the generation of PM/PM_{10}/$PM_{2.5}$ fugitive emissions from the casting frame operation; and
- No emission limit is being proposed since there is no formal method for quantifying emissions from this type of indoor operation.

4.3.4 BACT Analysis for PM_{10}/$PM_{2.5}$ Emissions from Natural Gas Combustion (AA-202)

Because natural gas is a gaseous fuel, filterable PM emissions from combustion are typically low. Particulate matter from natural gas combustion has been estimated to be less than 1 micrometer in size and has filterable and condensable fractions. Particulate matter from natural gas combustion is usually larger molecular weight hydrocarbons that are not fully combusted. Increased PM emissions may result from poor air/fuel mixing or maintenance problems[5].

Natural Gas Combustion Sources – Includes the following:

- AA-202: Ladle Pre-Heaters (Four 10 MMBtu/hr): 0.1 tpy $PM_{10}/PM_{2.5}$;

Step 1 – Identify Control Options, Step 2 – Eliminate Technically Infeasible Control Options, Step 3 – Rank Remaining Control Technologies by Control Effectiveness and Step 4 – Evaluate the Most Effective Controls and Document Results

There are no control options identified in the RBLC that are technically feasible to control $PM_{10}/PM_{2.5}$ that is emitted from small natural gas combustion units. See below table for summary of $PM_{10}/PM_{2.5}$ BACT determinations from the RBLC database:

Facility/ RBLC ID	Permit Date	Basis	Process	PM_{10} BACT Limit	$PM_{2.5}$ BACT Limit	Add-On Controls
SeverCorr LLC Columbus, Mississippi	07/15/11	BACT-PSD	Ladle preheaters, ladle dry-out heaters, Tundish preheaters, Tundish dry-out heaters, vertical ladle holding station, annealing furnaces, vacuum degasser boiler, boilers	None	None	Combustion of natural gas only
Nucor Steel, AR Blytheville, AR	06/10/11	BACT-PSD	Pickle Line Boilers, natural gas fired burners and dryers, ladle dryers	0.0076 lb/MMBtu	None	None
Sasol North America LA-0244	11/29/10	BACT-PSD	87.30 MMBtu/hr charge Heater	Total PM_{10}: 0.01 b/MMBtu	-	No controls
Sasol North America LA-0244	11/29/10	BACT-PSD	21.00 MMBtu/hr startup Heater	Total PM_{10}: 0.01 b/MMBtu	-	No controls

[5] AP 42, Fifth Edition, Volume I, Chapter 1.4: External Combustion Sources Natural Gas Combustion, July 1998

Facility/ RBLC ID	Permit Date	Basis	Process	PM_{10} BACT Limit	$PM_{2.5}$ BACT Limit	Add-On Controls
Lake Charles Cogeneration LLC LA-0231	06/22/09	BACT-PSD	34.20 MMBtu/hr Shift Reactor Startup Heater	Total PM_{10}: 0.007 b/MMBtu	-	Good design and proper operations
Competitive Power Ventures MD-0040	11/12/08	BACT-PSD	1.70 MMBtu/hr Heater	Filterable PM_{10}: 0.0070 b/MMBtu	Filterable 0.0070 lb/MMBtu (LAER)	No controls
Mid-American Steel and Wire Company OK-0128	09/08/08	BACT-PSD	Ladle Preheater and refractory drying	0.0076 b/MMBtu (total)	-	Combustion of natural gas
Thysenkrupp Steel and Stainless USA, LLC AL-0230	08/17/07	BACT PSD	33.40 MMBtu/hr Batch Annealing Furnaces	0.0076 b/MMBtu	-	No controls
Nucor Decatur, LLC AL-0231	06/12/07	BACT-PSD	98.7 MMBtu/hr Galvanizing Furnace	PM: 0.0076 b/MMBtu	-	No control
Republic Engineered Products, Inc OH-0303	08/30/05	LAER	Ladle Dryers/Preheaters	7.6 lb/mmscf (filterable)	7.6 lb/mmscf (filterable)	Good combustion control with proper natural gas burner design, no add-on controls
6Nucor Steel IN-0090	01/19/01	BACT-PSD	Ladle Preheaters	-	-	Combustion of natural gas or propane
Arkansas Steel Associates AR-0044	01/05/01	BACT-PSD	Ladle Preheaters	0.20 b/hr (filterable)	-	Natural gas combustion/ Good combustion practices

As shown in the above table, no add-on controls are used for PM_{10}/$PM_{2.5}$ from the natural gas combustion equipment.

Step 5 - Select BACT

The RACT/BACT/LAER Clearinghouse (RBLC) and review of other permits reveal that similar natural gas combustion devices use fuel specifications and good combustion practices for controlling PM emissions. No similar sized natural gas combustion devices were identified add-on PM controls as BACT.

Thus, BACT is defined as combustion of clean fuel and good combustion practices. For the natural gas combustion sources associated with the proposed Plant, combustion of natural gas and good combustion controls were the only control methods evaluated. Since the highest level of PM control as noted above will be implemented by MS Silicon, an analysis of economic, energy and environmental impacts was not performed.

BACT for the natural gas combustion devices is as follows:

- **Combustion of natural gas; and**
- **Good operating practices.**

4.3.5 BACT Analysis for PM_{10}/$PM_{2.5}$ from Material Storage and Handling (AA-101, AA-101a, AA-102, AA-102a, AA-103, AA-103a, AA-104, AA-301)

Raw materials will be received by truck at the site. The primary materials to be handled and stored at the silicon production plant are as follows:

- Coal;
- Wood;
- Limestone and
- Quartz.

Upon receipt the raw materials will be unloaded, conveyed and stored in outside piles. The raw materials will then be transferred via front end loaders to day bins in the submerged arc furnace building.

Add on control devices such as a baghouse or wet suppression will minimize particulate emission rates from material storage and handling. A baghouse is an air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags. Baghouses typically achieve PM control efficiencies of greater than 99%.

Wet suppression systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems: liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. Wet suppression systems typically achieve PM control efficiencies of 50-70%.

AA-101: Material Transfer to and from Coal Storage Pile

Coal will be delivered to the site either by truck. Fugitive emissions of PM will be generated during the receiving, transferring, and handling of coal.

Step 1 - Identify Available $PM_{10}/PM_{2.5}$ Control Technologies

- Add on control devices such as a fabric filter and enclosed conveyance can be used to minimize particulate emission rates from material storage and handling operations. A baghouse is an air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags. Fabric filters typically achieve PM control efficiencies of greater than 99%.
- Wet suppression systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems: liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. Wet suppression systems typically achieve PM control efficiencies of 50 to >90%.
- Best management plan (fugitive dust control plans) can provide for additional control of PM through managing the operations/equipment that generates the fugitive PM emissions. Implementation of these plans can reduce PM fugitive emissions by more than 50%.

Review of the RBLC database and recent permit applications indicated that viable PM controls for coal transfer to and from storage piles is a fugitive dust control plan (windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions as required). Refer to table below for a listing of recent BACT determinations for coal receiving and handling operations.

Step 2 - Elimination of Technically Infeasible Fugitive PM Control Alternatives

The above technologies are technically feasible and will be ranked for evaluation as part of the BACT evaluation for controlling particulate emissions from this operation.

- Fabric Filter control devices: 99% control efficiency – The emissions from this source are fugitive in nature and thus cannot be effectively captured and controlled.

- Wet Suppression: 50 to > 90% control efficiency - The use of wet suppression systems for this source is feasible.

- Implementation of fugitive dust control plan: >50% control efficiency.

Step 3 - Rank the Remaining Control Technologies by Control Effectiveness

The top ranked control option is fugitive dust control plan including the use of wet suppression on an as needed basis. No control options were eliminated for economic reasons.

Step 4 - Evaluate the Most Effective Controls and Document the Results

The table below lists the proposed particulate BACT determination, along with the existing particulate BACT determinations, for coal receiving and handling and coal transferring. All data in the table is based on the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

The limits being proposed by MS Silicon is equivalent to or lower than the BACT limitations established for coal handling operations at these facilities.

Existing PM/PM_{10}/$PM_{2.5}$ BACT Limits - Material Transfer to and from Coal Storage Pile

Facility	Date	Basis	Source	PM_{10}/$PM_{2.5}$ BACT Limit	BACT Control Method
East Kentucky Power Cooperative KY-0100	4/9/10	BACT-PSD	Coal Stockpile and unloading	PM: 10% opacity 3-minute	Wet suppression, dust suppressant, lowering well and compaction
Ohio River Clean Fuels, LLC OH-0317	11/20/08	BACT-PSD	Coal storage piles	PM_{10}: 12.3 tpy rolling 12-month period	3-Sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions
Martin Marietta Magnesia Specialties OH-0321	11/13/08	BACT-PSD	Coal and coke material handling	PM_{10}: 0.95 tpy rolling 12-month period	Building enclosure and high moisture content coal and coke >5%
Homeland Energy Solutions, LLC IA-0089	08/28/07	BACT-PSD	Coal receiving and handling	Filterable PM_{10}: 0.005 gr/dscf	Use of baghouse and water fogging. (Baghouse used to control storage bins and water fogging used to eliminate PM in unloading area
University of Northern Iowa IA-0086	5/3/07	BACT-PSD	Coal pile receiving and reclaim	Filterable PM_{10}: 095% control	Dust suppressant

Step 5 - Select BACT

BACT for the Material Transfer to and from Coal Storage Pile (AA-101) is proposed as the following:

- Best management practices including the incorporation 3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions;
- Development of a fugitive dust control plan to minimize PM emissions; and
- No emission limit is being proposed for this operation since there is no available test method to determine the $PM/PM_{10}/PM_{2\ 5}$ emission rate

Material Transfer to and from – Wood Storage Pile (AA-102)

Wood will be delivered to the site either by truck. Fugitive emissions of PM will be generated during the receiving, transferring, and handling of this material. Since these operations will have the potential to emit minor levels (due to the inherent moisture content of the wood to be handled and stored) of $PM_{10}/PM_{2\ 5}$ emissions and will typically be in the form of a fugitive type release, typical PM control technologies are not appropriate for these types of operations. The types of control measures used for materials handling operations can be classified as best management practices and include inherent pollution control techniques (covered conveyors, partially enclosed conveyor drop points, minimization of pile drop discharge distance, etc.).

Step 1 - Identify Available $PM_{10}/PM_{2.5}$ Control Technologies

- Add on control devices such as a fabric filter and enclosed conveyance can be used to minimize particulate emission rates from material storage and handling operations. A baghouse is an air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags. Fabric filters typically achieve PM control efficiencies of greater than 99%.
- Wet suppression systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems: liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. Wet suppression systems typically achieve PM control efficiencies of 50 to >90%.
- Best management plan (fugitive dust control plans) can provide for additional control of PM through managing the operations/equipment that generates the fugitive PM emissions. Implementation of these plans can reduce PM fugitive emissions by more than 50%.

Review of the RBLC database and recent permit applications indicated that viable PM controls for wood transfer to and from storage piles is a fugitive dust control plan (windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions as required). Refer to table below for a listing of recent BACT determinations for wood receiving and handling operations.

Step 2 - Elimination of Technically Infeasible Fugitive PM Control Alternatives

The above technologies are technically feasible and will be ranked for evaluation as part of the BACT evaluation for controlling particulate emissions from this operation.

- Fabric Filter control devices: 99% control efficiency – The emissions from this source are fugitive in nature and thus cannot be effectively captured and controlled.
- Wet Suppression: 50 to > 90% control efficiency - The use of wet suppression systems for this source is feasible.
- Implementation of fugitive dust control plan: >50% control efficiency.

Step 3 - Rank the Remaining Control Technologies by Control Effectiveness

The top ranked control option is fugitive dust control plan including the use of wet suppression on an as needed basis. No control options were eliminated for economic reasons.

Step 4 - Evaluate the Most Effective Controls and Document the Results

The table below lists the proposed particulate BACT determination, along with the existing particulate BACT determinations, for wood pile receiving, handling, and transferring. All data in the table is based on the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

The limits being proposed by MS Silicon is equivalent to or lower than the BACT limitations established for wood handling operations at these facilities.

Existing PM/PM_{10}/$PM_{2.5}$ BACT Limits – Wood Storage and Handling

Facility	Date	Basis	Source	PM_{10}/$PM_{2.5}$ BACT Limit	BACT Control Method
Southeast Regional Fuels, LLC FL-0322	12/23/10	BACT-PSD	Biomass material handling and preparation	5% opacity	To minimize fugitive, PM_{10} and $PM_{2.5}$, biomass conveyors shall be enclosed. Where required to meet the 5 % opacity requirement, the permittee shall install dust collectors on the conveyor transfer and drop points. The dust collectors shall be designed to obtain an outlet PM loading of 0.005 grains per dry standard cubic foot (gr/dscf). Additional practices: Enclosing material drop points, transfer points, shredders and screens wherever practical; Contouring storage piles to minimize wind erosion; Utilizing water sprays on storage piles as needed;

Facility	Date	Basis	Source	$PM_{10}/PM_{2.5}$ BACT Limit	BACT Control Method
Georgia Power Co. GA-0140	12/03/10	BACT-PSD	Biomass storage and handling	-	Partial enclosures for the conveyors; Partial enclosures for the transfer points
Ohio River Clean Fuels, LLC OH-0317	11/20/08	BACT-PSD	Biomass Storage Piles	AP-42 Calculation: 1.0 tpy fugitive PM_{10} No visible emissions except for 13-min in any 60-min period	3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions
Weyerhauser Co. LA-0201	05/24/06	BACT-PSD	Chip Handling	Filterable PM_{10} 0.0001 lb/T	Covered conveyors
Kingsford Manufacturing Company MS-0081	09/09/05	BACT-PSD	Wood Receipt	Filterable PM_{10}: 0.0020 lb/T wood	Good work practice standards and partial enclosure of truck dump area
			Wood Storage	Filterable PM_{10}: 0.0065 lb/T wood	Good work practice standards

The above table presents BACT limits for $PM_{10}/PM_{2.5}$ emissions from wood/biomass material handling operations. The limit being proposed by MS Silicon is equivalent to or lower than the BACT limitations established for other material handling operations at other types of facilities.

Review of state permits for similar operations (i.e., ferroalloy operations) revealed the following:

Facility/	Process	PM_{10} BACT Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009 Date: 11/26/10	Raw Material Handling - Raw Material Transfer and Storage operations begin with the receipt of raw materials via truck or rail. Coal, coke, charcoal, gravel, woodchips, and turnings are unloaded via crane to piles or directly to a below grade conveyor or pit. Coal is transferred to the pit, from which it is conveyed up to enclosed raw material storage bins or unloaded to outdoor storage piles. Gravel is unloaded to piles, transported by crane to a conveyor, screened, and conveyed up to enclosed storage bins. Wood chips are dumped from a trailer to the pit and transported up to enclosed storage bins. From indoor bins, the raw materials are weighed and dropped to a skip bucket from which they are transferred to the top of the furnace.	No limit	Enclosed storage bins
Globe Metallurgical Selma, AL 104-0001 Date: 9/10/10	Product Handling – Raw material receiving, transfer and storage	Process weight rate limitation 20% opacity in one 6-minute average in any 60 minute period	No add-on controls
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006 Date: 01/18/06	Raw material storage piles	No limit	None
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105 Date: 10/24/01	Raw material unloading and handling	20% opacity as a 3-minute average	Reasonable available control measures that are sufficient to minimize of eliminate visible emissions of fugitive dust

Facility/	Process	PM_{10} BACT Limit	Add-On Controls
	Raw Material and Waste Storage Piles – Load in or load out, wind erosion	No visible particulate emissions except for 13 minutes during any 60-minute period	Reasonable available control measures that are sufficient to minimize of eliminate visible emissions of fugitive dust

Step 5 -Select BACT

BACT for the wood material handling operations (AA-102) is proposed as the following:

- Best management practices including the incorporation 3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions;
- Development of a fugitive dust control plan to minimize PM emissions; and
- No emission limit is being proposed for this operation since there is no available test method to determine the PM/PM_{10}/$PM_{2\ 5}$ emission rate

Material Transfer to and from Quartz/Limestone Storage Piles (AA-103, AA-104)

Quartz and limestone will be delivered to the site either by truck. Fugitive emissions of PM will be generated during the receiving, transferring, and handling of these materials. Since these operations will have the potential to emit PM_{10}/$PM_{2.5}$ emissions and will typically be in the form of a fugitive type release, typical PM control technologies are not appropriate for these types of operations. The types of control measures used for materials handling operations can be classified as best management practices and include inherent pollution control techniques (covered conveyors, partially enclosed conveyor drop points, minimization of pile drop discharge distance, etc.).

Step 1 - Identify Available PM_{10}/$PM_{2.5}$ Control Technologies

- Add on control devices such as a fabric filter and enclosed conveyance can be used to minimize particulate emission rates from material storage and handling operations. A baghouse is an air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags. Fabric filters typically achieve PM control efficiencies of greater than 99%.
- Wet suppression systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by

combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems: liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. Wet suppression systems typically achieve PM control efficiencies of 50 to >90%.

- Best management plan (fugitive dust control plans) can provide for additional control of PM through managing the operations/equipment that generates the fugitive PM emissions. Implementation of these plans can reduce PM fugitive emissions by more than 50%.

Step 2 - Elimination of Technically Infeasible Fugitive PM Control Alternatives

The above technologies are technically feasible and will be ranked for evaluation as part of the BACT evaluation for controlling particulate emissions from this operation.

- Fabric Filter control devices: 99% control efficiency – The emissions from this source are fugitive in nature and thus cannot be effectively captured and controlled.
- Wet Suppression: 50 to > 90% control efficiency - The use of wet suppression systems for this source is feasible.
- Implementation of fugitive dust control plan: >50% control efficiency.

Step 3 - Rank the Remaining Control Technologies by Control Effectiveness

The top ranked control option is fugitive dust control plan including the use of wet suppression on an as needed basis. No control options were eliminated for economic reasons.

Step 4 - Evaluate the Most Effective Controls and Document the Results

Review of the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC) did not identify quartz handling and storage operations.

Review of state permits for similar operations (i.e., ferroalloy operations) revealed the following:

Facility/	Process	PM_{10} BACT Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009 Date: 11/26/10	Raw Material Handling - Raw Material Transfer and Storage operations begin with the receipt of raw materials via truck or rail. Coal, coke, charcoal, gravel, woodchips, and turnings are unloaded via crane to piles or directly to a below grade conveyor or pit. Coal is transferred to the pit, from which it is conveyed up to enclosed raw material storage bins or unloaded to outdoor storage piles. Gravel is unloaded to piles, transported by crane to a conveyor, screened, and conveyed up to enclosed storage bins. Wood chips are dumped from a trailer to the pit and transported up to enclosed storage bins. From indoor bins, the raw materials are weighed and dropped to a skip bucket from which they are transferred to the top of the furnace.	No limit	Enclosed storage bins
Globe Metallurgical Selma, AL 104-0001 Date: 9/10/10	Product Handling – Raw material receiving, transfer and storage	Process weight rate limitation 20% opacity in one 6-minute average in any 60 minute period	No add-on controls
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006 Date: 01/18/06	Raw material storage piles	No limit	None

Facility/	Process	PM_{10} BACT Limit	Add-On Controls
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105 Date: 10/24/01	Raw material unloading and handling	20% opacity as a 3-minute average	Reasonable available control measures that are sufficient to minimize of eliminate vis ble emissions of fugitive dust
	Raw Material and Waste Storage Piles – Load in or load out, wind erosion	No visible particulate emissions except for 13 minutes during any 60-minute period	Reasonable available control measures that are sufficient to minimize of eliminate vis ble emissions of fugitive dust

The limit being proposed by MS Silicon is equivalent to or lower than the BACT limitations established for other material handling operations at other types of facilities.

Step 5 -Select BACT

BACT for the quartz and limestone storage pile handling operations (AA-103, AA-104) is proposed as the following:

- Best management practices including the incorporation 3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any visible emissions;
- Development of a fugitive dust control plan to minimize PM emissions; and
- No emission limit is being proposed for these operations since there is no available test method to determine the $PM/PM_{10}/PM_{2\ 5}$ emission rate.

<u>Material Handling (Coal, Wood, Quartz) Baghouse (AA-101a, AA-102a, AA-103a) and Product Handling Area Baghouse (AA-301 and AA-403)</u>

Material from the storage piles will be conveyed via front end loaders to enclosed day bins. From the day bins, the raw materials will be weighed and dropped to a skip bucket from which they will be transferred to the top of one (1) of four (4) semi-enclosed submerged arc furnaces for processing.

Step 1 - Identify Available PM_{10}/$PM_{2.5}$ Control Technologies

Since these operations will have the potential to emit PM_{10}/$PM_{2.5}$ emissions and will typically be in the form of point source release, these emission can be controlled using the particulate matter controls described in previous sections of this document.

Step 2 - Elimination of Technically Infeasible PM_{10}/$PM_{2.5}$ Control Alternatives

The test for technical feasibility of any control option is whether it is both available and applicable to reducing PM_{10}/$PM_{2.5}$ emissions from the SAF operations. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) ESPs - use an electrostatic field to charge particulate matter contained in the gas stream and then attract and collect the particles on a collection surface of opposite charge. ESPs have very high removal efficiencies (99% or better) for many sources of particulates. However, they are not suitable for all types of applications. Due to the electromagnetic properties of small charged particles of metal compounds in an electric field, the particles adhere very strongly to the collection plates of an ESP and are extremely difficult to dislodge, resulting in ineffectivity of the ESP. Therefore, ESP is considered technically infeasible for controlling particulate emissions from the SAF.

(b) High Efficiency Cyclones - Particulate removal in cyclone collectors is achieved through the action of inertial forces, especially centrifugal. As the gas stream enters the top of the cyclone, a vortex is induced as it is forced to travel a circular path. Centrifugal forces cause the heavier particles to concentrate near the outer wall of the cyclone and particle of lesser mass to remain closer to the center of the vortex. Frictional and gravitational forces then act on the particles closest to the wall, causing them to fall toward the bottom of the cyclone, where they are collected in a hopper. Within the lower segment of the cyclone, the direction of the gas-flow vortex is reversed, and an inner ascending vortex is formed. The inner vortex consists of comparatively particulate-free air, which is collected through an outlet duct at the top of the cyclone. Cyclone collectors are considered technically feasible. However, they achieve the lowest particulate removal efficiencies (less than 90%) of all particulate control devices, especially for submicron particulates that will be emitted from the SAF.

(c) High Energy Scrubbers - High energy wet scrubbers are technically feasible and can achieve a high particulate collection efficiency (90% or better), but at the expense of a punitive pressure drop (ranging from 6 - 20 inches of water), higher operational utilities, generation of large quantities of sludge along with the associated problem of sludge handling, de-watering, and disposal.

(d) Fabric filters or baghouses are technically feasible for collecting fine particulate matter emissions associated with SAFs or other types of furnaces that have high particulate emissions. They can also achieve the highest control efficiency, among other particulate control devices, as applied to SAF operations.

(i) Positive pressure baghouses operate at internal pressures greater than the atmospheric pressure. Typically, the fans are located before the fabric filters. This allows the fans to pull air from the SAF and push the dust laden air through the fabric filters and into the ambient air via a continuous ridge vent (old design) rather than a stack. The discharge area of a ridge vent is on the order of four times that of a single stack.

(ii) Negative pressure baghouses operate at internal pressure less than atmospheric. The fans are located after the fabric filters. This allows the fans to pull the gas laden air from the SAF, through the fabric filters, and then push the air up through a central stack.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

The following remaining control options are in order of descending control effectiveness:

(a) Fabric filters or baghouses - 99.9%;

(b) High Energy Scrubbers - 90% or more; or

(c) High Efficiency Cyclones - 50 to 90%.

Step 4 – Evaluate the Most Effective Controls and Document Results

Fabric filtration is the predominant control option for abatement of particulate emissions from material handling operations due to their effectiveness. Scrubbers and cyclones are not considered as effective as fabric filters or baghouses for controlling particulate emissions from silicon production operations.

Step 5 -Select BACT

BACT for the raw material and product handling operations (AA-101a, AA-102a, AA-103a, AA-301, AA-403) is proposed as the following:

- Baghouse for PM control; and
- A $PM_{10}/PM_{2.5}$ limitation of 0.003 gr/dscf.

It should be noted that MS Silicon is voluntarily designing the baghouse to meet 0.0015 gr/dscf to minimize the potential impact on $PM_{10}/PM_{2.5}$ air quality. This emission rate does not constitute BACT.

4.3.6 BACT Analysis for $PM_{10}/PM_{2.5}$ Emissions from Silica Fume Silos (AA-404)

Silica fumes collected in the SAF baghouses will be pneumatically transferred to the silica fume silos. In the silos, the silica fumes will be densified to about 45 lbs/cu.ft., prior to dispatch to cement and refractory manufacturers that can use this dust in their other operations (i.e., cement and refractory).

Step 1 - Identify Available $PM_{10}/PM_{2.5}$ Control Technologies

Since these operations will have the potential to emit $PM_{10}/PM_{2.5}$ emissions and will typically be in the form of point source release, these emission can be controlled using the particulate matter controls described in previous sections of this document.

Step 2 - Elimination of Technically Infeasible $PM_{10}/PM_{2.5}$ Control Alternatives

The test for technical feasibility of any control option is whether it is both available and applicable to reducing $PM_{10}/PM_{2.5}$ emissions from the SAF operations. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) ESPs - use an electrostatic field to charge particulate matter contained in the gas stream and then attract and collect the particles on a collection surface of opposite charge. ESPs have very high removal efficiencies (99% or better) for many sources of particulates. However, they are not suitable for all types of applications. Due to the electromagnetic properties of small charged particles of metal compounds in an electric field, the particles adhere very strongly to the collection plates of an ESP and are extremely difficult to dislodge, resulting in ineffectivity of the ESP. Therefore, ESP is considered technically infeasible for controlling particulate emissions from the SAF.

(b) High Efficiency Cyclones - Particulate removal in cyclone collectors is achieved through the action of inertial forces, especially centrifugal. As the gas stream enters the top of the cyclone, a vortex is induced as it is forced to travel a circular path. Centrifugal forces cause the heavier particles to concentrate near the outer wall of the cyclone and particle of lesser mass to remain closer to the center of the vortex. Frictional and gravitational forces then act on the particles closest to the wall, causing them to fall toward the bottom of the cyclone, where they are collected in a hopper. Within the lower segment of the cyclone, the direction of the gas-flow vortex is reversed, and an inner ascending vortex is formed. The inner vortex consists of comparatively particulate-free air, which is collected through an outlet duct at the top of the cyclone. Cyclone collectors are considered technically feasible. However, they achieve the lowest particulate removal efficiencies (less than 90%) of all particulate control devices, especially for submicron particulates that will be emitted from the SAF.

(c) High Energy Scrubbers - High energy wet scrubbers are technically feasible and can achieve a high particulate collection efficiency (90% or better), but at the expense of a punitive pressure drop (ranging from 6 - 20 inches of water), higher operational utilities, generation of large quantities of sludge along with the associated problem of sludge handling, de-watering, and disposal.

(d) Fabric filters or baghouses are technically feasible for collecting fine particulate matter emissions associated with SAFs or other types of furnaces that have high particulate emissions. They can also achieve the highest control efficiency, among other particulate control devices, as applied to SAF operations.

(i) Positive pressure baghouses operate at internal pressures greater than the atmospheric pressure. Typically, the fans are located before the fabric filters. This allows the fans to pull air from the SAF and push the dust laden air through the fabric filters and into the ambient air via a continuous ridge vent (old design) rather than a stack. The discharge area of a ridge vent is on the order of four times that of a single stack.

(ii) Negative pressure baghouses operate at internal pressure less than atmospheric. The fans are located after the fabric filters. This allows the fans to pull the gas laden air from the SAF, through the fabric filters, and then push the air up through a central stack.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

The following remaining control options are in order of descending control effectiveness:

(a) Fabric filters or baghouses - 99.9%;

(b) High Energy Scrubbers - 90% or more; or

(c) High Efficiency Cyclones - 50 to 90%.

Step 4 – Evaluate the Most Effective Controls and Document Results

Fabric filtration is the predominant control option for abatement of particulate emissions from these operations. Scrubbers and cyclones are not considered as effective as fabric filters or baghouses for controlling particulate emissions from silicon production operations.

Step 5 -Select BACT

BACT for the silica fume silos (AA-404) is proposed as the following:

- Bin vent filter for PM control; and
- A $PM_{10}/PM_{2.5}$ limitation of 0.01 gr/dscf.

4.3.7 BACT Analysis for $PM_{10}/PM_{2.5}$ Emissions from Emergency Equipment (AA-501)

The emergency equipment includes the following:

- Diesel-Fired Emergency Generator (1 rated at 670-HP): 0.001 tpy $PM_{10}/PM_{2.5.}$

Step 1 – Identify Control Options

There are no control options identified in the RBLC that are technically feasible to control $PM_{10}/PM_{2.5}$ that is emitted from emergency generators. See below table for summary of PM BACT determinations from the RBLC database.

Step 2 - Technical Feasibility of $PM_{10}/PM_{2.5}$ Control Alternatives

The emergency diesel fired generator associated with the proposed project will be used primarily for emergency situations, if any. However, to maintain the integrity of the equipment, the generator will be operated for 100 hours per year or less. The projected annual $PM_{10}/PM_{2.5}$ emissions rate is 0.001 tpy. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank Remaining Alternatives by Control Effectiveness

The most effective method for control of $PM_{10}/PM_{2.5}$ emissions from operation of the emergency fuel combustion devices is the use of fuel specifications that employ clean burning fuels, implementation of good combustion practices and use of combustion controls inherent to the design of the individual combustion devices.

Step 4 - Evaluate Most Effective Controls

Since there are no other feasible technologies to control $PM_{10}/PM_{2.5}$ emissions from the emergency equipment, economic, energy and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

The following table lists the existing $PM_{10}/PM_{2.5}$ BACT determinations for diesel fired emergency equipment. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Facility/ RBLC ID	Permit Date	Process	$PM_{10}/PM_{2.5}$ BACT Limit	Add-On Controls
Southeast Renewable Fuels (FL-0322)	12/23/10	Emergency ULSD Generators (two 2,682 HP)	Total PM: 0.2 g/KW-H	No controls The emergency generators shall comply with the emission limit and demonstrate compliance in accordance with the procedures given in NSPS 40 CFR 60, Subpart IIII.
		Emergency ULSD Fire Pump (One 600 HP)	Total PM: 0.15-g/HP-hr	No controls The fire pumps shall comply with the emission limit and demonstrate compliance in accordance with the procedures given in NSPS 40 CFR 60, Subpart IIII.
Idaho Power Company ID-0018	6/25/10	750 KW Emergency Diesel Generator	PM: 0.2 g/KW-H -H	Tier 2 Engine, Good combustion practices
Consumers Energy (MI-0389	12/29/09	2000 KW Emergency ULSD Generator	Total PM: 0.2 g/KW-H Total PM_{10}: 0.0573 g/KW-H	Engine design and operation, 15 ppm sulfur fuel Operational Limits: 1 hr/day, 500 hrs/yr for $PM_{2.5}$ NAAQS
Verenium (FL-0318)	12/10/09	2000 KW Emergency generators	Total PM: 0.2 g/KW-H	None

Facility/ RBLC ID	Permit Date	Process	$PM_{10}/PM_{2.5}$ BACT Limit	Add-On Controls
		Emergency ULSD Fired Pump	Total PM: 0.15-g/HP-hr	The fire pump engine is an Emergency Stationary Compression Ignition Internal Combustion Engine (Stationary ICE) and shall comply with applicable provisions of 40 CFR 60, Subpart IIII
Lake Charles Cogeneration, LLC (LA-0231)	06/22/09	Emergency Diesel Power Generator Engines (1341 HP)	Total PM_{10} 0.06 lb/h	Comply with 40 CFR 60 Subpart IIII
Southeast Idaho Energy, LLC (ID-0017)	2/10/09	2 MW Emergency Generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII, ULSD fuel, limited to 100 hours of operation per year
		500 KW emergency generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII, ULSD fuel, limited to 100 hours of operation per year
Associated Electric Cooperative Inc (OK-0129)	1/23/09	2200 HP low sulfur diesel emergency generator	Total PM_{10}: 0.2 g/KW-H	None
		267 HP low sulfur diesel emergency fir pump	Total PM_{10}: 0.4 G/HP-H	

As shown in the table above, BACT for the emergency equipment is compliance with NSPS IIII and good combustion/operating practices.

Step 5 – Select BACT for $PM_{10}/PM_{2.5}$ from Emergency Equipment

BACT is proposed as compliance with NSPS IIII and good combustion/operating practices.

4.3.8 BACT analysis for $PM_{10}/PM_{2.5}$ Emissions from Wood Chipper (AA-102b)

The portable electric wood chipper will be used for as needed wood grinding/chipping and will be limited to 2080 hours per year of operation. Fugitive particulate emissions can occur from operation of the wood chipper (AA-102b). The wood chipper operation design will include an enclosure that will minimize fugitive dust emissions.

Step 1 – Identify Control Options

Due to the limited hours of operation and the fugitive nature of the operation, there are no control options that are technically feasible to control $PM_{10}/PM_{2.5}$ that is emitted from wood chippers.

Step 2 - Technical Feasibility of $PM_{10}/PM_{2.5}$ Control Alternatives

No wood chippers were identified in the RBLC database. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank the Remaining Control Technologies

The only remaining technically feasible method for control of particulate emissions resulting from operation of the wood chipper is an enclosure that will minimize fugitive dust emissions and limited hours of operation. The combination of these control methods represents the Top-Rated control.

Step 4- Evaluate the Most Effective Control

Since there are no other feasible technologies available that could achieve the same level of PM control as that being proposed for the wood chipper, equipment, economic, energy, and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

Step 5 - Select BACT

The following has been proposed as BACT for controlling PM emissions from the wood chipper:

- Operation of the wood chipper with an enclosure or similar that will minimize fugitive dust emissions;
- Limited hours of operation for the wood chipper; and
- No emission limit is being proposed for this operation since there are no available test methods to determine the $PM/PM_{10}/PM_{2.5}$ emission rate.

4.3.9 BACT analysis for $PM_{10}/PM_{2.5}$ Emissions from Bulldozer Storage Pile Processing (AA-105)

Bulldozers will be used to groom and maintain the storage piles. The emissions from these operations are fugitive in nature.

Step 1 – Identify Control Options

Due to the fugitive nature of the operation, there are no add-on control options that are technically feasible to control $PM_{10}/PM_{2.5}$ that is emitted from bulldozing the storage piles. Review of the RBLC database and other silicon plant permits did not identify similar operations.

Step 2 - Technical Feasibility of $PM_{10}/PM_{2.5}$ Control Alternatives

Based on the nature of the operation, the only viable controls are the use of best management practices (i.e., dust minimization techniques including as needed water spray application and wind screens).

Step 3 - Rank the Remaining Control Technologies

The only remaining technically feasible method for control of particulate emissions resulting from bulldozing operations on the storage piles is the use of best management practices (i.e., dust minimization techniques including as needed water spray application and wind screens). The combination of these control methods represents the Top-Rated control.

Step 4- Evaluate the Most Effective Control

Since there are no other feasible technologies available that could achieve the same level of PM control as that being proposed for the storage pile processing operations, equipment, economic, energy, and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

Step 5 - Select BACT

The following has been proposed as BACT for controlling PM emissions from the storage pile processing (AA-105):

The proposed BACT for storage pile processing (bulldozing) associated with this project is:

- The development of a dust control plan including the use of measures designed to eliminate dust such as application of wet suppressants, watering, wind screens and speed reduction, as required; and
- No emission limit is being proposed for this operation since there are no available test methods to determine the $PM/PM_{10}/PM_{2.5}$ emission rate.

4.3.10 BACT Analysis for $PM_{10}/PM_{2.5}$ Emissions from Storage Pile Wind Erosion (AA-106)

PM emissions may be generated by wind erosion from the storage piles. Because the material stored will be fairly heavy and will not consist of a fine dust-like material, potential emissions should be minimal.

Step 1 - Identification of Available $PM/PM_{10}/PM_{2.5}$ Controls

- Add on control devices such as a fabric filter and enclosed conveyance can be used to minimize particulate emission rates from material storage and handling operations. A baghouse is an air pollution abatement device used to trap particulates by filtering gas streams through large fabric bags. Fabric filters typically achieve PM control efficiencies of greater than 99%.

- Wet suppression systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems: liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. Wet suppression systems typically achieve PM control efficiencies of 50 to >90%.
- Best management plan (fugitive dust control plans) can provide for additional control of PM through managing the operations/equipment that generates the fugitive PM emissions. Implementation of these plans can reduce PM fugitive emissions by more than 50%.

Step 2 - Elimination of Technically Infeasible PM/PM_{10}/$PM_{2.5}$ Control Alternatives

The above technologies are technically feasible and will be ranked for evaluation as part of the BACT evaluation for controlling particulate emissions from this operation.

- Fabric Filter control devices: 99% control efficiency – The emissions from this source are fugitive in nature and thus cannot be effectively captured and controlled.
- Wet Suppression: 50 to > 90% control efficiency - The use of wet suppression systems for this source is feasible.
- Implementation of fugitive dust control plan: >50% control efficiency

Step 3 - Rank the Remaining Control Technologies by Control Effectiveness

The top ranked control option is fugitive dust control plan including the use of wet suppression on an as needed basis and the implementation of a fugitive dust control plan.

Step 4 - Evaluate the Most Effective Controls and Document the Results

The following table lists existing particulate BACT determinations, for material storage pile operations. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Material Storage Areas					
Facility	**Date**	**Basis**	**Source**	**$PM/PM_{10}/PM_{2.5}$ BACT Limit**	**BACT Control Method**
Nucor Steel OH-0341	12/23/10	BACT-PSD	Scrap steel storage piles	Fugitive PM - 0.43 ton/yr Fugitive PM_{10} - 0.22 ton/yr Fugitive $PM_{2.5}$ - 0.06 ton/yr	Minimize drop height
Consolidated Environmental Management – Nucor Steel LA-0239	5/24/10	BACT-PSD	Coal Storage Pile	Total PM - 3.99 ton/yr	BACT is selected to be implementation of wet suppression of dust generating sources by water sprays at each storage pile site
			Slag processing storage piles	Total PM - 1.19 ton/yr	BACT is selected to be wet suppression of dust generating sources by water sprays
			Iron Ore Pellet storage piles	Filterable PM - 13.88 ton/yr	BACT is selected to be implementation of wet suppression of dust generating sources by water sprays at each storage pile site
			Flux storage piles	Filterable PM - 2.18 ton/yr	BACT is selected to be implementation of wet suppression of dust generating sources by water sprays at each storage pile site
			Granulated slag storage piles	Filterable PM - 2.18 ton/yr	BACT is selected to be implementation of wet suppression of dust generating sources by water sprays at each storage pile site
Osceola Steel Company, Georgia	3/15/10	BACT-PSD	Slag storage piles	No Emission limit	The control method is source control, either through minimizing drop height or wet suppression of the material. In addition, roadways and stockpiles of slag to be processed will also be treated by wet suppression

Material Storage Areas					
Facility	**Date**	**Basis**	**Source**	**$PM/PM_{10}/PM_{2.5}$ BACT Limit**	**BACT Control Method**
Ohio River Clean Fuels, LLC OH-0317	11/20/08	BACT-PSD	Coal Storage Piles	Fugitive PM - 12.3 tpy PM_{10}	3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any vis ble emissions
			Biomass Storage Piles	Fugitive PM - 2.7 tpy PM_{10}	3-sided windscreen barrier, reduced drop heights, use of chemical stabilization dust suppressants and/or watering to reduce any vis ble emissions
			Slag storage piles	Fugitive PM 1.6 ton/yr from wind 11.7 ton/yr load out	Use of water trucks or fire hoses to maintain high moisture content. Water applied for load out. Minimize free fall distances. Haul trucks covered.
Nucor Steel, Indiana	6/1/12	BACT-PSD	Slag Storage	<u>Opacity limits:</u> Stockpiling of slag adjacent to the grizzly feeder = 3 % Wind erosion of stockpiles = 3% Continuous stacking of processed slag to stockpiles = 3%	Fugitive Dust Control Plan

<u>Step 5 -Select BACT</u>

Proposed BACT for Material Storage Pile Operations (AA-106):

- Implementation of a fugitive dust control plan. Visible emissions from the storage piles shall be controlled by the application of water, other dust suppressants or the use of wind screens, as needed.

- No emission limit is being proposed for these operations since there is no available test method to determine the PM/PM_{10}/$PM_{2.5}$ emission rate.

4.3.11 BACT Analysis for PM_{10}/$PM_{2.5}$ Emissions from Paved and Unpaved Roads

Fugitive particulate emissions can occur from paved and unpaved surfaces.

Step 1: Identify all control technologies

The RACT/BACT/LAER (RBLC) Clearinghouse and review of other permits reveal that the PM control for paved and unpaved roads includes the use dust suppressants, roadway sweeping, covering of transport vehicles, and speed limits.

Add-on Control Technology:

Watering and the use of chemical wetting agents are the principal means for control of emissions from materials handling operations involving transfer of bulk minerals in aggregate form. Dust control can be achieved by: (a) source extent reduction (e.g., mass transfer reduction), (b) source improvement related to work practices and transfer equipment such as load in and load out operations (e.g., drop height reduction, wind sheltering, moisture retention), and (c) surface treatment (e.g., wet suppression).

In most cases, good work practices provide substantial opportunities for emission reduction without the need for investment in a control application program. In particular, spillage of material caused by pile lead-out and maintenance equipment can add a large source component associated with traffic entrained dust. The traffic dust component may easily dominate over emissions from transfer of material and wind erosion. The prevention of spillage and subsequent spreading of material by vehicles traversing the area is essential to cost-effective emission control. If spillage cannot be prevented because of the need for intense use of mobile equipment in the storage pile area, then regular cleanup should be employed as a necessary mitigative measure.

Fugitive emissions from paved roadways can also be controlled by wet suppression systems. These systems use liquid sprays or foam to suppress the formation of airborne dust. The primary control mechanisms are those that prevent emissions through agglomerate formation by combining small dust particles with larger aggregate or with liquid droplets. The key factors that affect the degree of agglomeration and, hence, the performance of the system are the coverage of the material by the liquid and the ability of the liquid to wet small particles. There are two types of wet suppression systems—liquid sprays which use water or water/surfactant mixtures as the wetting agent and systems which supply foams as the wetting agent. The wetting agent can be water or a combination of water and a chemical surfactant. This surfactant, or surface active agent, reduces the surface tension of the water. As a result, the quantity of liquid needed to achieve good control is reduced.

Step 2: Eliminate Technically Infeasible Options

The PM control options noted above are feasible control alternatives. Therefore, there is no elimination of technically infeasible fugitive PM control alternatives. There are no other known control alternatives (per review of the BACT/LAER clearinghouse) that have been utilized on roads.

Step 3: Rank Remaining Technically Feasible Control Options

Development of a fugitive dust control plan which includes removal of deposits on roadways, speed limitation on vehicle traffic and wet suppression techniques as needed will be employed as BACT for paved and unpaved roads.

Step 4: Evaluate the Most Effective Controls and Document the Results

The following table lists the proposed particulate BACT determination along with the existing particulate BACT determinations for the paved and unpaved roads. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse identified the following with respect to paved roads:

Facility/ RBLC ID	Permit Date	Basis	Process	PM BACT Limit	Add-On Controls
V&M Star OH-0344	1/27/11	BACT-PSD	Paved and unpaved roadways and parking areas	Fugitive PM10: 7.7 tpy	Employ best available control measures: watering, sweeping, chemical stabilization, or suppressants applied at sufficient frequencies
Nucor Steel OH-0341	12/23/10	BACT-PSD	Roadways	Fugitive PM10: 5.93 tpy	Best available control measures to include watering, resurfacing, chemical stabilization, and/or speed reduction at sufficient frequency to ensure compliance
Flopam, Inc. LA-0240	06/14/10	BACT-PSD	Roadway Fugitives	Total PM10: 0.04 lb/hr	Main roadway shall be paved where practical. Precautions shall be taken to prevent dust from becoming airborne

Facility/ RBLC ID	Permit Date	Basis	Process	PM BACT Limit	Add-On Controls
Consolidated Environmental Management, Inc LA-0239	05/24/10	BACT-PSD	Unpaved Road Fugitive Dust	18.69 lb/hr 81.85 tpy	BACT for road dust is to pave roadways where practicable including areas where the extra heavy vehicles (greater than 50 tons in weight) will not cause damage to paving. Unpaved roads shall utilize water spray or dust suppression chemicals to reduce emissions. Additionally, reduced speed limits of less than or equal to 15 mph will be enforced on all unpaved roadways
V&M Star OH-0328	04/10/09	BACT-PSD	Roadways and parking areas	Filterable PM_{10}: 12.4 tpy using AP-42 emission factors	Control measures sufficient to minimize or eliminate emissions
Rumke Sanitary Landfill OH-0330	12/23/08	BACT-PSD	Paved roadways and parking areas	Filterable PM_{10}: 15.1 tpy	Best available control measures to minimize or prevent emissions, including water flushing and sweeping of paved roads/parking areas; and applying water or other dust suppressant to unpaved roads..
Southwest Electric Power Company AR-0094	11/05/08	BACT-PSD	Roads	PM: 1.1 lb/hr	Watering/dust suppression chemicals
New Steel International, Inc. OH-0315	05/06/08	BACT-PSD	Paved roadways and parking areas	PM: 153.4 tpy fugitive dust	Control measures include application of wet suppressants, watering, speed reduction and vacuuming or sweeping

Based on information presented reviewed for this BACT analysis, the $PM_{10}/PM_{2.5}$ control measures presented above focus solely on measures designed to eliminate dust such as application of wet suppressants, watering, speed reduction and vacuuming or sweeping. No other applicable $PM_{10}/PM_{2.5}$ control measures were identified in this review.

BACT for paved and unpaved roads associated with this project is proposed as:

- The development of a dust control plan including the use of measures designed to eliminate dust such as application of wet suppressants, watering, speed reduction and vacuuming or sweeping, as required; and
- No emission limit is being proposed for emissions from paved and unpaved roads since there are no available test methods to determine the PM/PM_{10}/$PM_{2.5}$ emission rate.

4.4 Best Available Control Technology (BACT) Analysis - Emissions of NO_x

The BACT evaluation focuses on the control technologies that have been demonstrated and commercially available for control of NO_x emissions. Because of the importance of controlling these emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes so that emissions of NO_x will be controlled to the levels specified.

Nitrogen oxides formation occurs by three fundamentally different mechanisms. The principal mechanism of NO_x formation in natural gas combustion is thermal NO_x. The thermal NO_x mechanism occurs through the thermal dissociation and subsequent reaction of nitrogen (N_2) and oxygen (O_2) molecules in the combustion air. Most NO_x formed through the thermal NO_x mechanism occurs in the high temperature flame zone near the burners. The formation of thermal NO_x is affected by three furnace-zone factors: (1) oxygen concentration, (2) peak temperature, and (3) time of exposure at peak temperature. As these three factors increase, NO_x emission levels increase. The emission trends due to changes in these factors are fairly consistent for all types of natural gas-fired boilers and furnaces. Emission levels vary considerably with the type and size of combustor and with operating conditions (e.g., combustion air temperature, volumetric heat release rate, load, and excess oxygen level). The second mechanism of NO_x formation, called prompt NO_x, occurs through early reactions of nitrogen molecules in the combustion air and hydrocarbon radicals from the fuel. Prompt NO_x reactions occur within the flame and are usually negligible when compared to the amount of NO_x formed through the thermal NO_x mechanism. However, prompt NO_x levels may become significant with ultra-low-NO_x burners. The third mechanism of NO_x formation, called fuel NO_x, stems from the evolution and reaction of fuel-bound nitrogen compounds with oxygen. Due to the characteristically low fuel nitrogen content of natural gas, NO_x formation through the fuel NO_x mechanism is insignificant. [6]

4.4.1 NO_x Emission Sources Subject to Control Technology Evaluation

The NO_x emission sources associated with the proposed plant that are included in this NO_x BACT evaluation are as follows:

- Semi-Enclosed Submerged Arc Furnaces (SAFs);
- Natural gas fired combustion equipment; and
- Emergency equipment.

[6] AP 42, Fifth Edition, Volume I, Chapter 1.4: External Combustion Sources Natural Gas Combustion, July 1998

For a summary of the estimated NO_x emission rates for the sources identified above, please refer to the following table:

NO_x Emission Rates for Sources Evaluated for BACT

Equipment Description	NO_x Emission Rate (tons/year)
Semi-Enclosed Submerged Arc Furnace (SAFs)	1892.2
Natural Gas Combustion Equipment • Ladle preheaters	14.0
Emergency Equipment: • Emergency Generators	0.02
Total	**1906.2**

4.4.2 BACT Analysis for NO_x Emissions from Submerged Arc Furnaces (AA-201)

Step 1 – Identify Control Options

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling NO_x emissions from plant operations:

1. On-line USEPA Control Technology Database;
2. State Air Quality Permits; and
3. Control Technology Vendors.

The following control technologies were identified and evaluated to control NO_x emissions from the semi-enclosed submerged arc furnace (SAF):

(a) Combustion Controls;

(b) Selective Catalytic Reduction (SCR);

(c) Non-Selective Catalytic Reduction (NSCR);

(d) SCONO$_x$ Catalytic Oxidation/Absorption; and

(e) Shell DeNO$_x$ System (modified SCR);

(1) Selective Non-Catalytic Reduction (SNCR) options -

(2) Exxon's Thermal DeNO$_x$ ®

(3) Nalco Fuel Tech's NO$_x$OUT®

(4) Low Temperature Oxidation (LTO).

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing NO$_x$ emissions from the SAF. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) Combustion Controls - There is an entire group of combustion controls for NO$_x$ reduction from various combustion units as follows:

1. Low Excess Air (LEA) - This control option is typically used in conjunction with some of the other options. The use of this option will result in the generation of additional CO emissions, which is another pollutant under review in this BACT analysis. In addition, LEA is not very effective for implementation in electric arc furnaces that do not operate with combustion air feeds, since the combustion option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.
2. Oxyfuel Burner - The SAF system does not employ natural gas-fired oxyfuel burners, thus, this option will be excluded for further consideration in this BACT analysis.
3. Overfire Air (OFA) - This control option is geared primarily for fuel NO$_x$ reduction, which is not the major NO$_x$ formation mechanism from SAFs. Further, this option is associated with potential operational problems due to low primary air, creating incomplete combustion conditions. Such conditions can result in inefficient processing and unacceptable increases in tap-to-tap times. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.
4. Burners Out Of Service (BOOS) - BOOS and Load Reduction (or Deration) options - incorporate a reduction in furnace load, thereby, potentially reducing NO$_x$ formation. This reduction must be balanced, however, against a longer period of NO$_x$ generation resulting from the furnace's inability to efficiently melt material. Furthermore, both BOOS and Load Reduction are fundamentally inconsistent with the design criterion for the furnace, which is to increase furnace loadings to achieve enhanced production. Therefore, these control options are not technically feasible for this particular application and will not be considered any further in this BACT analysis.

5. Reduced Combustion Air Temperature - This control option inhibits thermal NO_x production. However, the option is limited to equipment with combustion air preheaters which are not applicable to the silicon production operations. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

6. Flue Gas Recirculation (FGR) - FGR option involves recycling a portion of the cooled exit flue gas back into the primary combustion zone. Typically, FGR is useful in reducing thermal NO_x formation by lowering the oxygen concentration in the combustion zone. The primary limitation of FGR is that it alters the distribution of heat (resulting in cold spots) and lowers the efficiency of the furnace. Since it may be necessary to add additional burners (hence, increasing emissions of other pollutants) to the SAF to reduce the formation of cold spots, FGR technology to reduce SAF NO_x emissions is not considered feasible. Since the SAF does not operate on burner combustion, but relies upon the electric arc and chemical energy for oxidation, neither pathway is amenable to FGR application. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(b) Selective Catalytic Reduction (SCR) -- In this process, ammonia (NH_3), usually diluted with air or steam, is injected through a grid system into the exhaust gas stream upstream of a catalyst bed. On the catalyst surface the NH_3 reacts with NO_x to form molecular nitrogen and water. The basic reactions are as follows:

$4NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O$ (i)

$8NH_3 + 6NO_2 \rightarrow 7N_2 + 12H_2O$ (ii)

The reactions take place on the surface of the catalyst. Usually, a fixed bed catalytic reactor is used for SCR systems. The function of the catalyst is to effectively lower the technology include the catalyst reactor design, optimum operating temperature, sulfur content of the charge, catalyst deactivation due to aging, ammonia slip emissions and design of the ammonia injection system.

Depending on system design, NO_x removal of 80 - 90 percent may be achievable under optimum conditions (refer, USEPA "ACT Document - NO_x Emissions from Iron and Silicon productions", Sept., 1994). The reaction of NH_3 and NO_x is favored by the presence of excess oxygen. Another variable affecting NO_x reduction is exhaust gas temperature. The greatest NO_x reduction occurs within a reaction window at catalyst bed temperatures between 600 ^oF – 750 ^oF for conventional (vanadium or titanium-based) catalyst types, and 470 ^oF – 510 ^oF for platinum-based catalysts. Performance for a given catalyst depends largely on the temperature of the exhaust gas stream being treated. A given catalyst exhibits optimum performance when the temperature of the exhaust gas stream is at the midpoint of the reaction temperature window for applications where exhaust gas oxygen concentrations are greater than 1 percent. Below the optimum temperature range, the catalyst activity is greatly reduced, potentially allowing unreacted ammonia (referred to as “ammonia slip”) to be emitted directly to the atmosphere.

The SCR system may also be subject to catalyst deactivation over time. Catalyst deactivation occurs through two primary mechanisms – physical deactivation and chemical poisoning. Physical deactivation is generally the result of either continual exposure to thermal cycling or masking of the catalyst due to entrainment of particulates or internal contaminants. Catalytic poisoning is caused by the irreversible reaction of the catalyst with a contaminant in the gas stream. Catalyst suppliers typically guarantee a 3-year catalyst lifetime for a sustainable emission limit.

In order for an SCR system to effectively reduce NO_x emissions, the exhaust gas stream should have relatively stable gas flow rates, NO_x concentrations, and temperature. In addition, certain elements such as iron, nickel, chrome, and zinc can react with platinum catalysts to form compounds or alloys which are not catalytically active. These reactions are termed “catalytic poisoning”, and can result in premature replacement of the catalyst. An SAF flue gas may contain a number of these catalytic poisons. In addition, any solid material in the gas stream can form deposits and result in fouling or masking of the catalytic surface. Fouling occurs when solids obstruct the cell openings within the catalyst. Masking occurs when a film forms on the surface of catalyst over time. The film prevents contact between the catalytic surface and the flue gas. Both of these conditions can result in frequent cleaning and/or replacement requirements. Due to the above effective technical applicability constraints, SCR technology has never been applied to silicon production operations, and will be eliminated for further evaluation in this BACT analysis.

(c) Non-Selective Catalytic Reduction (NSCR) - The NSCR system is a post-combustion add-on exhaust gas treatment system. It is often referred to as a “three-way conversion” catalyst since it reduces NO_x, unburned hydrocarbons (UBH), and CO simultaneously. In order to operate properly, the combustion process must be stoichiometric or near stoichiometric which is not maintained in an SAF and varies widely under regular operation. Under stoichiometric conditions, in the presence of the catalyst, NO_x is reduced by CO, resulting in nitrogen and carbon dioxide. Currently, NSCR systems are limited to rich-burn IC engines with fuel rich ignition system applications. In view of the above limitations, the NSCR option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(d) $SCONO_x$-Catalytic Oxidation/Absorption -- This is a catalytic oxidation/absorption technology that has been applied for reductions of NO_x, CO and VOC from an assortment of combustion applications that mostly include – small turbines, boilers and lean-burn engines. However, this technology has never been applied to silicon production operations.

An effective $SCONO_x$ application to a SAF has the following reservations:

(1) The technology is not readily adaptable to high-temperature applications outside the 300-700 ^oF range and is susceptible to thermal cycling that will be experienced in the MS Silicon application;

(2) Scale-up is still an issue. The technology has not been demonstrated for larger applications;

(3) Optimum $SCONO_x$ operation is predicated by stable gas flow rates, NO_x concentrations and temperature. As discussed earlier, the nature of SAF operations does not afford any of these conditions which will significantly impair the effective control efficiency of the $SCONO_x$ system;

(4) The catalyst is susceptible to moisture interference and the vendor indicates negation of its warranties and performance guarantees if the catalyst is exposed to any quantity of liquid water. However, during certain atmospheric conditions, the catalyst could be potentially exposed to moisture following a unit shutdown;

(5) The prospect of moving louvers that effect the isolation of the saturated catalyst readily lends itself to the possibility of thermal warp and in-duct malfunctions in general. The process is dependent on numerous hot-side dampers that must cycle every 10-15 minutes. Directional flow solutions are not yet known to have been implemented for this technology;

(6) The K_2CO_3 coating on the catalyst surface is an active chemical reaction and reformulation site which makes it particularly vulnerable to fouling. On some field installations, the coating has been found to be friable and tends to foul in the harsh in-duct environment;

(7) During the regeneration step, the addition of the flammable reducing gas (natural gas which contains 85% methane) into the hot flue gas generates the possibility of LEL exceedances and subsequently catastrophic failure in the event the catalyst isolation is not hermetic or there is a failure in the carrier steam flow; and

(8) There is a possibility of some additional SO_2 emissions if the dry scrubber with the tandem "guard-bed" $SCOSO_x$ unit experiences a malfunction. Thus, there are significant reservations regarding effective technical applicability of this control alternative for a silicon production SAF application. Moreover $SCONO_x$ technology has never been proposed nor successfully implemented for similar industry applications. In view of the above limitations, $SCONO_x$ is considered technically infeasible for the present application and will not be considered any further in this BACT analysis.

(e) Shell $DeNO_x$ System (modified SCR) - The Shell $DeNO_x$ system is a variant of traditional SCR technology which utilizes a high activity dedicated ammonia oxidation catalyst based on a combination of metal oxides. The system is comprised of a catalyst contained in a modular reactor housing where in the presence of ammonia NO_x in the exhaust gas is converted to nitrogen and water. The catalyst is contained in a low-pressure drop lateral flow reactor (LFR), which makes best use of the plot space available. Due to the intrinsically high activity of the catalyst, the technology is suited for NO_x conversions at lower temperatures with a typical operating range of 250-660 ^{o}F.

The low temperature operation is the only aspect of the Shell $DeNO_x$ technology that marks its variance from traditional SCR technology. From an SAF application standpoint, there are no additional differences between this technology and SCR technology.

In summary, an effective Shell $DeNO_x$ application to the SAF application has the following reservations:

(1) The Shell $DeNO_x$ system does not suffer from similar placement limitation considerations discussed earlier for SCRs. However, even a downstream of the SAF baghouse placement of the system does not render it completely safe from the prospect of particulate fouling. The catalyst will still be exposed to particulates, which can inflict a masking effect impairing the effective control efficiency of the system;

(2) Optimum Shell $DeNO_x$ operation is predicated by stable gas flow rates, NO_x concentrations and temperature. The nature of silicon production operations does not afford any of these conditions which will significantly impair the effective control efficiency of the Shell $DeNO_x$ system;

(3) The catalyst is particularly susceptible to thermal fluctuations;

(4) The use of relatively large amounts of ammonia - a regulated toxic chemical – will have accidental release and hazardous impact implications; and

(5) Even a 7 parts per million by volume (ppmv) ammonia slip from a 500,000 acfm exhaust gas flow can result in a significant increase of emissions of ammonia which is a regulated hazardous air pollutant with well documented health impacts.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for an SAF application. Moreover Shell $DeNO_x$ has never been proposed nor successfully implemented for similar applications. Therefore, the Shell $DeNO_x$ option is considered technically infeasible and will not be considered any further in this BACT analysis.

(f) Selective Non-Catalytic Reduction (SNCR) - The three commercially available SNCR systems are Exxon's Thermal $DeNO_x$ ® system, Nalco Fuel Tech's NO_xOUT® system and Low Temperature Oxidation (LTO). These technologies are reviewed below for technical feasibility in controlling SAF NO_x emissions.

(1) Exxon's Thermal $DeNO_x$ ® - Exxon's Thermal $DeNO_x$ ® system is a non-catalytic process for NOx reduction. The process involves the injection of gas-phase ammonia (NH_3) into the exhaust gas stream to react with NO_x. The ammonia and NO_x react according to the following competing reactions:

$2NO + 4NH_3 + 2O_2 \rightarrow 3N_2 + 6H_2O$ (i)

$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$ (ii)

The temperature of the exhaust gas stream is the primary criterion controlling the above selective reaction. Reaction (i) dominates in the temperature window of 1,600 ^oF - 2,200 ^oF resulting in a reduction of NO_x. However above 2,200 ^oF, reaction (ii) begins to dominate, resulting in enhanced NO_x production. Below 1,600 ^oF, neither reaction has sufficient activity to produce or destroy NOx. Thus, the optimum temperature window for the Thermal $DeNO_x$® process is approximately 1,600 ^oF - 1,900 ^oF. The above reaction temperature window can be shifted down to approximately 1,300 ^oF - 1,500 ^oF with the introduction of readily oxidizable hydrogen gas. In addition, the process also requires a minimum of 1.0 second residence time in the desired temperature window for any significant NO_x reduction.

In order for the Thermal $DeNO_x$ ® system to effectively reduce NO_x emissions, the exhaust gas stream should have relatively stable gas flow rates; ensuring the required residence time and be within the prescribed temperature range. Based on review of readily available information, application of Thermal $DeNO_x$® technology to control NO_x emissions from silicon production operations are not known. Therefore, this option is considered technically infeasible and will not be considered any further in this BACT analysis.

In summary, an effective Thermal DeNO$_x$ ® application to the SAF application has the following reservations:

(A) The placement of the Thermal DeNO$_x$ ® system in an adequate temperature regime. In order to achieve optimum operational efficiency the system should be located in a temperature region of at least 1,300 ^{o}F and preferably between 1,600 ^{o}F - 1,900 ^{o}F which would put it upstream of the SAF baghouse. Such a placement configuration would not afford the desired temperature range, which would be typically in the region of 300 ^{o}F - 400 ^{o}F with an entry temperature of 250 ^{o}F at the inlet to the SAF baghouse. The system cannot be placed further upstream for operational hazard reasons. Also any injection mechanism upstream of the baghouse will be susceptible to prompt particulate fouling;

(B) Optimum Thermal DeNO$_x$ ® operation is predicated by stable gas flow rates, NO$_x$ concentrations and temperature. The nature of silicon production operations does not afford any of these conditions which will significantly impair the effective control efficiency of the Thermal DeNO$_x$ ® system; and

(C) The use of relatively large amounts of ammonia - a regulated toxic chemical - will have accidental release and hazardous impact implications.

(2) Nalco Fuel Tech's NO$_x$OUT® - The NO$_x$OUT® process is very similar in principle to the Thermal DeNO$_x$ ® process, except that it involves the injection of a liquid urea (NH_2CONH_2) compound (as opposed to NH_3) into the high temperature combustion zone to promote NO$_x$ reduction. The chemical reaction proceeds as follows:

$NH_2 + NO \rightarrow N_2 + H_2O$ (i)

The reaction involves the decomposition of urea at temperatures of approximately 1,700 ^{o}F - 3,000 ^{o}F. Certain proprietary additive developments have allowed the operational temperature window to shift to approximately 1,400 ^{o}F - 2,000 ^{o}F. However, the process still has similar constraints as the Thermal DeNO$_x$ ® system. The limitations are dictated by the reaction-controlling variables such as stable gas flow rates for a minimum residence time of 1.0 second in the desired temperature window to ensure proper mixing.

As with the Thermal DeNO$_x$ ® system, the NO$_x$OUT® system suffers from essentially similar limitations to effectively reduce NOx emissions from SAF operations. Moreover, applications of the NO$_x$OUT® technology to control NOx emissions from silicon production operations are not known. Therefore, this option is considered technically infeasible and will not be considered any further in this BACT analysis.

Similar to the Thermal DeNO$_x$® application, an effective NO$_x$OUT® application to the SAF application has the following reservations:

(A) The placement of the NO$_x$OUT® system in an adequate temperature regime. In order to achieve optimum operational efficiency the system should be located in a temperature region preferably between 1,400 ^{o}F - 2,000 ^{o}F which would put it upstream of the SAF baghouse. Firstly, such a placement configuration would not afford the desired temperature range, which would be typically in the region of 300 ^{o}F -400 ^{o}F with an entry temperature of 250 ^{o}F at the inlet to the SAF baghouse. Also any injection mechanism upstream of the baghouse will be susceptible to prompt particulate fouling;

There are significant reservations regarding effective technical applicability of this control alternative for an SAF application. In order for the NO$_x$OUT® system to effectively reduce NO$_x$ emissions, the exhaust gas stream should have relatively stable gas flow rates, ensuring the requisite residence time requirements and temperature. The temperature of the SAF exhaust gas will vary widely over the melt cycle, and will not remain in the desired temperature window during all phases of operation. Similarly, the gas flow rates will not remain stable during furnace operation, precluding the possibility of adequate residence time. Moreover, NO$_x$OUT® technology has never been proposed nor successfully implemented to control NO$_x$ emissions from SAFs.

(3) Low Temperature Oxidation (LTO) - LTO technology has never been utilized for any silicon production application. The technology is a variant of SNCR technology using ozone. The ozone is injected into the gas stream and the NO$_x$ in the gas stream is oxidized to nitrogen pentoxide (N_2O_5) vapor, which is absorbed in the scrubber as dilute nitric acid (HNO_3). The nitric acid is then neutralized with caustic (NaOH) in the scrubber water forming sodium nitrate ($NaNO_3$). The overall chemical reaction can be summarized as follows:

$NO_2 + NO + 2O_3 + NaOH \rightarrow HNO_3 + NaNO_3 + 2O_2$ (i)

For optimal performance, the technology requires stable gas flows, lack of thermal cycling, invariant pollutant concentrations and residence times on the order of 1 - 1.5 seconds. In addition, LTO technology requires frequent calibration of analytical instruments, which sense the NO$_x$ concentrations for proper adjustment of ozone injection. Since LTO uses ozone injection, it has a potential for ozone slip, which can vary between 5 - 10 ppmv. Also, the technology requires a cooler flue gas of less than 300 ^{o}F at the point of ozone injection; otherwise the reactive gas is rendered redundant. The technology also suffers from low NO$_x$ conversion rates (40% - 60%), potential for nitric acid vapor release (in the event of a scrubber malfunction) with subsequent regional haze impacts and the handling, treatment and disposal issues for the spent scrubber effluent.

The technology is neither applicable nor proven for silicon production SAF applications and attendant limitations render it technically infeasible in its current manifestation. In view of the above, the LTO control option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

All control alternatives identified in Step 2 were eliminated as not technically feasible for controlling NO_x emissions from the silicon production operations, with the exception of good operating combustion practices.

Step 4 – Evaluate the Most Effective Controls and Document Results

Good operating and combustion practices were the only technically feasible control option in controlling NO_x emissions from the SAF.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for SAFs or any other sources associated with the silicon production operations. Review of state permit information identified the following with respect to SAFs at silicon production plants:

Facility/ RBLC ID	Permit Date	Process	NO_x Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009	11/26/10	Two submerged-arc semi-enclosed-type electric furnaces (22 MW/hr)	NOx: 87.6 lb/hr Capacity: 22 MW/hr NOx: 4.0 bs/MW	No control
Globe Metallurgical Selma, AL 104-0001	9/10/10	20 MW Electric Arc Furnaces (2) producing silicon metal	NOx: 66.0 lb/hr Capacity: 20 MW/hr NOx: 3.3 bs/MW	No control
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006	01/18/06	Electric submerged arc furnace No. 15 for the production of silicon metal and ferroalloys	NOx: 462 tpy NOx: 110 lb/hr Nominal Capacity: 18,000 tons/yr NOx: 51.3 lbs/ton silicon	No controls
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105	10/24/01	Electric Arc Furnaces (Ferrosilicon and Silicon metal production furnaces)	None	No controls

As shown in the above table, NO_x emissions from SAFs are uncontrolled. None of the sources as reflected in the above table have proposed or successfully implemented any add-on control devices to control NO_x emissions from SAFs operation.

MS Silicon is proposing the NO_x BACT for the SAFs (AA-201) as follows:

- **NO_x emissions from each of the SAFs shall be limited to 45 lbs/ton (averaged over a 30-day period) of silicon produced.**

4.4.3 BACT Analysis for NO_x Emissions from Natural Gas Combustion

Natural Gas Combustion Sources – Includes the following:

- Ladle Pre-Heaters (4 – 10.0 MMBtu/hr): 14 tpy $NO_{x;}$

Step 1 – Identify Control Options, Step 2 – Eliminate Technically Infeasible Control Options, Step 3 – Rank Remaining Control Technologies by Control Effectiveness and Step 4 – Evaluate the Most Effective Controls and Document Results

There are no control options identified in the RBLC that are technically feasible to control NO_x that is emitted at from each combustion unit. See below table for summary of NO_x BACT determinations from the RBLC database:

Facility/ RBLC ID	Permit Date	Basis	Process	NO_x BACT Limit	Controls
SeverCorr LLC Columbus, Mississippi	07/15/11	BACT-PSD	Ladle preheaters, ladle dry-out heaters, Tundish preheaters, Tundish dry-out heaters, vertical ladle holding station	0.08 to 0.1 lb/MMBtu	Combustion of natural gas only
Nucor Steel, Marion, Inc. OH-0341	12/23/10	BACT-PSD	Ladle preheaters, tundish preheaters	Mass emission rate of 27.60 lb/hr	Use of natural gas low NO_x burners.
Osceola Steel Co., Adel, Georgia	3/15/10	BACT-PSD	Preheaters	0.1 lb/MMBtu	Combustion of natural gas, good combustion practices

Facility/ RBLC ID	Permit Date	Basis	Process	NO_x BACT Limit	Controls
Mid-American Steel and Wire Company OK-0128	09/08/08	BACT-PSD	3 Ladle Preheater and 2 refractory drying	0.10 lb/MMBtu	Combustion of natural gas
Minnesota Steel Industries, LLC MN-0070	09/07/07	BACT-PSD	Ladle/Tundish Preheater	No limit	Natural gas combustion and low NO_x burners
Gerdau Ameristeel Wilton IA-0087	05/29/07	BACT-PSD	North Ladle Dryer, South Ladle Dryer and Preheaters, Northwest Ladle Dryers	100 lb/mmscf	Good combustion practices
Nucor Steel AR-0090	04/03/06	BACT-PSD	Ladle Dryer	0.1000 lb/MMBtu	Low NO_x burners
Republic Engineered Products, Inc. OH-0303	08/30/05	LAER	Ladle Dryers/Preheaters	0.1000 lb/MMBtu	Low NO_x burners
Charter Manufacturing Co. Inc. Charter Steel OH-0276	06/10/04	BACT-PSD	Ladle Preheater and Dryers	0.98 b/hr 4.29 ton/yr Limits are for each preheater	None
Nucor Corp TX-0417	1/15/03	BACT-PSD	Process heaters, ladle and tundish	0.100 lb/MMBtu	Low NO_x burners and clean fuel
Nucor Steel IN-0090	01/19/01		6 Ladle Preheaters	0.100 lb/MMBtu, 6.0 lb/hr total	Low NO_x burners

As shown in the above table, no controls other than low NO_x burners, good combustion practices and combustion of clean fuel are used for NO_x emissions from the natural gas combustion equipment.

Step 5 - Select BACT

The RACT/BACT/LAER Clearinghouse (RBLC) and review of other permits reveal that similar natural gas combustion devices use fuel specifications and good combustion practices for controlling NO_x emissions. No similar sized natural gas combustion devices were identified using add-on NO_x controls as BACT.

Thus, BACT is defined as combustion of clean fuel, low NO_X burners, and good combustion practices. For the natural gas combustion sources associated with the proposed Plant, combustion of natural gas and good combustion controls were the only control methods evaluated. Since the highest level of NO_x control as noted above will be implemented by MS Silicon, an analysis of economic, energy and environmental impacts was not performed.

Thus, BACT is defined as:

- **NO_x emission rate of 0.08 lbs/MMBtu;**
- **Low NO_x or equivalent burners/technology;**
- **Combustion of clean fuel; and**
- **Good combustion practices.**

4.4.4 BACT Analysis for NO_x Emissions from Emergency Equipment (AA-501)

Emergency Equipment – Includes the following:

- Diesel-Fired Emergency Generator (1 rated at 670-HP):0.02 tpy $NO_{x;}$

Step 1 – Identify Control Options

There are no control options identified in the RBLC that are technically feasible to control NO_x that is emitted from emergency generators. See below table for summary of NO_x BACT determinations from the RBLC database:

Step 2 - Technical Feasibility of NO_x Control Alternatives

The emergency distillate generator will be used primarily for emergency situations, if any. However, to maintain the integrity of the equipment, the generator will be operated for 100 hours per year or less. The projected annual NOx emissions rate is 0.02 tpy. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank Remaining Alternatives by Control Effectiveness

The most effective method for control of NO_x emissions from operation of the emergency fuel combustion devices is the use of fuel specifications that employ clean burning fuels, implementation of good combustion practices and use of combustion controls inherent to the design of the individual combustion devices.

Step 4 - Evaluate Most Effective Controls

Since there are no other feasible technologies to control NO_x emissions from the emergency generator, economic, energy and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

The following table lists the existing NO_x BACT determinations for diesel fired emergency generators. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Facility/ RBLC ID	Permit Date	Process	NO_x BACT Limit	Add-On Controls
Southeast Renewable Fuels (FL-0322)	12/23/10	Emergency ULSD Generators (two 2,682 HP)	6.4 G/KW-H NOX+NMHC	No controls The emergency generators shall comply with the emission limit and demonstrate compliance in accordance with the procedures given in NSPS 40 CFR 60, Subpart IIII.
Idaho Power Company (ID-0018)	6/25/10	Emergency Diesel Generator	6.4 G/KW-H NOx+NMHC	Tier 2 Engine, Good combustion practices
Consumers Energy (MI-0389	12/29/09	Emergency ULSD Generator	6.4 G/KW-H NOx+NMHC	Engine design and operation
Verenium (FL-0318)	12/10/09	Emergency generators	6.4 G/KW-H NOx+NMHC	None
Lake Charles Cogeneration, LLC (LA-0231)	06/22/09	Emergency Diesel Power Generator Engines (1341 HP)	17.09 b/h	Comply with 40 CFR 60 Subpart IIII
Southeast Idaho Energy, LLC (ID-0017)	2/10/09	2 MW Emergency Generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII
		500 KW emergency generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII
Associated Electric Cooperative Inc (OK-0129)	1/23/09	2200 HP low sulfur diesel emergency generator	6.4 G/KW-H NOx+NMHC	None

As shown in the table above, BACT for the emergency equipment is compliance with NSPS IIII; good combustion/operating practices, and the use of ultra-low sulfur diesel (ULSD) fuel.

Step 5 – Select BACT for NO_x from Emergency Equipment (AA-501)

BACT is proposed as:

- **Compliance with NSPS IIII;**
- **Good combustion/operating practices, and**
- **Use of ULSD.**

4.5 Best Available Control Technology (BACT) Analysis - Emissions of CO

The BACT evaluation focuses on the control technologies that have been demonstrated and commercially available for control of CO emissions. Because of the importance of controlling these emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes so that emissions of CO will be controlled to the levels specified.

Large amounts of carbon monoxide and organic materials are emitted by submerged electric arc furnaces. Carbon monoxide is formed as a byproduct of the chemical reaction between oxygen in the metal oxides of the charge and carbon contained in the reducing agent (coke, coal, etc.). Reduction gases containing organic compounds and carbon monoxide continuously rise from the high-temperature reaction zone, entraining fine particles and fume precursors. The mass weight of carbon monoxide produced sometimes exceeds that of the metallic product.[7]

4.5.1 CO Emission Sources Subject to Control Technology Evaluation

The CO emission sources associated with the proposed plant that are included in this CO BACT evaluation are as follows:

- Semi-Enclosed Submerged Arc Furnaces;
- Natural gas fired combustion equipment; and
- Emergency equipment.

For a summary of the estimated CO emission rates for the sources identified above, please refer to the following table:

CO Emission Rates for Sources Evaluated for BACT

Equipment Description	CO Emission Rate (tons/year)
Semi-Enclosed Submerged Arc Furnace	1429.6
Natural Gas Combustion Equipment • Ladle preheaters	14.4

[7] AP-42 Chapter 12.4 Ferroalloy Production, 10/86

Equipment Description	CO Emission Rate (tons/year)
Emergency Equipment: • Emergency Generator	0.19
Total	1444.3

A summary of the BACT determinations for CO is presented in Table 4-4.

4.5.2 BACT Analysis for CO Emissions from Semi-Enclosed Submerged Arc Furnaces (AA-201)

Step 1 – Identify Control Options

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling emissions from the semi-enclosed submerged electric arc furnaces:

1. On-line USEPA Control Technology Database; and
2. State Air Quality Permits

The following control technologies were identified and evaluated to control CO emissions from the SAFs:

(a) Operating Practice Modifications;

(b) Flaring of CO Emissions;

(c) CO Oxidation Catalysts;

(d) Post-Combustion Reaction Chamber;

(e) Catalytic Incineration; and

(f) Oxygen Injection.

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing CO emissions from the SAF. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) Operating Practice Modifications -- Due to marketplace demands on the type of products to be manufactured and the required product quality, MS Silicon does not propose any additional operating practice modifications that will alter CO emissions from the existing semi-enclosed SAF. Therefore, this control option will be eliminated for further evaluation in this BACT analysis.

(b) Flaring of CO Emissions -- Based upon a review of the previously listed information resources, there is no known application of flaring SAF exhaust gases. Flaring of emissions for CO destruction would require raising the exhaust gas temperature. Thus, based on the relatively large gas volumetric flow at a substantial temperature differential, the auxiliary fuel requirements needed to operate the flare would be overwhelmingly large. Additionally, it can be speculated as to whether the flare would actually result in a decrease of CO emissions or increase thereof from supplemental fuel combustion, which would also result in an increase of NO_x emissions. Consequently, this control alternative is considered technically infeasible for SAF exhausts and thus, will not be considered any further in this BACT analysis.

(c) CO Oxidation Catalysts -- Based upon a review of the previously listed information resources, there is no known application of CO oxidation catalysts to control CO emissions from a SAF. The optimal working temperature range for CO oxidation catalysts is approximately 850 ^{o}F - 1,100 ^{o}F with a minimum exhaust gas stream temperature of 500 ^{o}F for minimally acceptable CO control. Exhaust gases from the SAF will undergo rapid cooling as they are ducted from the furnace. Thus, the temperature will be far below the minimum 500 ^{o}F threshold for effective operation of CO oxidation catalysts. Additionally, the particulate loading in the exhaust gas stream is anticipated to be too high for efficient operation of a CO oxidation catalyst. Masking effects such as plugging and coating of the catalyst surface would almost certainly result in impractical maintenance requirements, and would significantly degrade the performance of the catalyst. Consequently, this control alternative is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(d) Post-Combustion Reaction Chambers -- Based upon a review of the previously listed information resources, there is no known successful application of duct burners or thermal incinerators to control CO emissions from silicon production operations. The feasibility of these units to effectively reduce CO emissions, without resulting in severe operational problems, is unknown. Further, such units are expected to consume large quantities of natural gas and oxygen; resulting in excessive annual operating costs.

The principle of destruction within post combustion chambers is to raise the SAF exhaust gases to a sufficiently high temperature and for a minimum amount of time to facilitate oxidation. The combustion chamber configuration must provide effective mixing within the chamber with an acceptable residence time. Recuperative heat exchangers can be used with these systems to recover a portion of the exiting exhaust gas heat and reduce the auxiliary fuel consumption.

The amount of CO which could be oxidized with post combustion systems is uncertain, and precise performance guarantees are expected to be difficult to obtain from equipment manufacturers because of the lack of operating experience. In addition, there is the potential for additional emissions of CO from auxiliary fuel combustion. Further, due to the heat and particulate loading, the burners would have a short life expectancy, and may sustain severe maintenance and reliability problems. Additionally, a single or multiple duct burner system would not be able to heat the relatively cool gases from the SAF during cold cycling. Potentially, there are two locations where post combustion chambers can be installed, i.e., upstream or downstream of an SAF baghouse. Locating upstream of the baghouse would take advantage of slightly elevated temperatures in the exhaust gas stream. However, at this location, the post combustion chamber would be subject to high particulate loading. The units would be expected to foul frequently from the particulate accumulation, and the burners would have severe maintenance and reliability problems. Thus, the installation of the post combustion chamber upstream of the baghouse is considered technically infeasible. Alternatively, the post combustion chamber could be installed downstream of the SAF baghouse. However, even at this location, fouling due to particulate matter can occur and more importantly, even cooler exhaust temperatures would be encountered. These cooler temperatures would greatly increase the auxiliary fuel requirements. Further, the combustion of additional fuel will result in increases in emissions to the atmosphere.

Based upon the above discussions, the use of a post combustion chamber is considered technically infeasible for the silicon production operations and will not be considered any further in this BACT analysis.

(e) Catalytic Incineration -- Based upon a review of the previously listed information resources, there is no known application of catalytic incineration to control CO emissions from silicon production operations. Catalytic incinerators use a bed of catalyst that facilitates the overall combustion of combustible gases. The catalyst increases the reaction rate and allows the conversion of CO to CO_2 at lower temperatures than a thermal incinerator. The catalyst is typically a porous noble metal material which is supported in individual compartments within the unit. An auxiliary fuel-fired burner ahead of the bed heats the entering exhaust gases to 500 ^{o}F – 600 ^{o}F to maintain proper bed temperature. Recuperative heat exchangers are used to recover the exiting exhaust gas heat and reduce the auxiliary fuel consumption. Secondary energy recovery is typically 70 percent.

Catalytic incineration systems are limited in application due to potential poisoning, deactivation, and/or blinding of the catalyst. Lead, arsenic, vanadium, and phosphorus are generally considered poisons to catalysts and deactivate the available reaction sites on the catalyst surface. Particulate can also build up on the catalyst, effectively blocking the porous catalyst matrix and rendering the catalyst inactive. In cases of significant levels of poisoning compounds and particulate loading, catalyst replacement costs are significant.

As in the thermal incineration discussion, potentially, there are two locations where the incinerator can be installed, i.e., upstream or downstream of the SAF baghouse. For the same reasons discussed earlier (e.g., fouling due to particulate matter), the upstream location is considered technically infeasible. Alternatively, the incinerator can be installed downstream of the meltshop baghouse. However, even at this location, fouling due to particulate matter can occur, and further, the exhaust will be at a lower temperature. These cooler temperatures would greatly increase the auxiliary fuel requirements. The associated combustion of additional auxiliary fuel will result in an unacceptable increase in operating costs. Further, the combustion of additional fuel will result in increases in emissions to the atmosphere.

Due to the lack of application of catalytic incineration for SAFs and potentially adverse technology applicability issues, this control alternative is considered technically infeasible and will not be considered any further in this BACT analysis.

(f) Oxygen Injection -- Based upon a review of the previously-listed information resources, there is no known application of oxygen injection for controlling CO emissions from SAFs.

A theoretical means of reducing CO would be oxygen injection at the entrance of the ductwork to increase oxidation of the available CO to CO_2. The increase in CO oxidation which could be achieved, however, is unknown. This approach would be purely experimental and is a procedure that is currently not conducted in silicon production operations in silicon productions in the United States. Consequently, this control alternative is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

All control alternatives identified in Step 2 were eliminated as not technically feasible for controlling CO emissions from the SAF.

Step 4 – Evaluate the Most Effective Controls and Document Results

Good operating practices are only technically feasible control option in controlling CO emissions from the SAF.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for submerged arc furnaces or any other sources associated with the silicon production operations. Review of state permit information identified the following with respect to submerged electric arc furnaces at silicon production plants:

Facility/ RBLC ID	Permit Date	Process	CO Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009	11/26/10	Two submerged-arc semi-enclosed-type electric furnaces (22 MW/hr)	No limit	No control
Globe Metallurgical Selma, AL 104-0001	9/10/10	20 MW Electric Arc Furnaces (2) producing silicon metal	CO: 88.9 b/hr Capacity: 20 MW/hr CO: 4.4 lbs/MW	No control
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006	01/18/06	Electric submerged arc furnace No. 15 for the production of silicon metal and ferroalloys	CO: 54.0 b/hr Nominal Capacity: 2 tons/hr CO: 27 lbs/ton silicon	No controls
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105	10/24/01	Electric Arc Furnaces (Ferrosilicon and Silicon metal production furnaces)	None	No controls

As shown in the above table, CO emissions from submerged electric arc furnaces are uncontrolled. None of the sources as reflected in the above table have proposed or successfully implemented any add-on control devices to control CO emissions from SAF operation.

MS Silicon is proposing the BACT for CO as follows:

- **Total CO emissions from the SAF shall be limited to 34 lbs/ton (averaged over a 30-day period) of silicon produced;**
- **Good combustion and operating practices; and**
- **Utilization of a semi-enclosed SAF design.**

4.5.3 BACT Analysis for CO Emissions from Natural Gas Combustion (AA-202)

Natural Gas Combustion Sources – Includes the following:

- Ladle Pre-Heaters (4 – 10.0 MMBtu/hr): 14.4 tpy CO;

Step 1 – Identify Control Options,

According to information available in the RBLC, EPA's Compilation of Air Pollutant Emission Factors and the EPA's CATC Technical Bulletins and Air Pollution Control Technology Fact Sheets, there are no reasonably available add-on control options to control CO emissions from natural gas combustion units. This review did not identify natural gas combustion equipment associated with silicon production employing add-on controls to control combustion related emissions from natural gas combustion sources.

Step 2 – Eliminate Technically Infeasible Control Options

No technically feasible control options were identified to control the small quantities of CO from similar sized natural gas combustion equipment.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness and Step 4 – Evaluate the Most Effective Controls and Document Results

No technically feasible control options were identified.

Step 5 - Select BACT

The RACT/BACT/LAER Clearinghouse (RBLC) and review of other permits reveal that similar natural gas combustion devices use fuel specifications and good combustion practices for controlling CO emissions. No similar sized natural gas combustion devices were identified add-on CO controls as BACT.

Facility/RBLC ID	Permit Date	Basis	Process	CO BACT Limit	Add-On Controls
Mid-American Steel and Wire Company OK-0128	09/08/08	BACT-PSD	Ladle Preheater and refractory drying	0.0840 lb/MMBtu	Combustion of natural gas
New Steel International, Inc OH—0315	5/6/08	BACT-PSD	Tundish Preheaters	0.0840 lb/MMBtu	Natural gas combustion
Gerdau Ameristeel Wilton IA-0087	05/29/07	BACT-PSD	North Ladle Dryer, South Ladle Dryer and Preheaters, Northwest Ladle Dryers	84 lb/mmscf	Good combustion practices

Facility/RBLC ID	Permit Date	Basis	Process	CO BACT Limit	Add-On Controls
Nucor Steel AR-0090	04/03/06	BACT-PSD	Ladle Dryer	0.0840 lb/MMBtu	Good combustion practice
Republic Engineered Products, Inc OH-0303	08/30/05	LAER	Ladle Dryers/Preheaters	84.0 lb/Mmscf	Best operational and engineering practices
Charter Manufacturing Co. Inc. Charter Steel OH-0276	06/10/04	BACT-PSD	Tundish Preheaters	0.0820 lb/MMBtu each preheater	None
Charter Manufacturing Co. Inc. Charter Steel OH-0276	06/10/04	BACT-PSD	Ladle Preheater and Dryers	0.0820 lb/MMBtu each preheater	None
Nucor Steel IN-0090	01/19/01	BACT-PSD	Tundish Preheaters	No limit	Use of natural gas
Nucor Steel IN-0090	01/19/01	BACT-PSD	Ladle Preheaters	No limit	Natural gas or propane combustion

As shown in the above table, no controls other than good combustion practices and combustion of clean fuel are used for CO emissions from the natural gas combustion equipment. The variation of 0.0820 to 0.0840 lb/MMBtu is based on different heating values for natural gas.

Thus, BACT for CO emissions from equipment combusting natural gas is defined as:

- **CO emission rate of 0.0840 lbs/MMBtu;**
- **Combustion of natural gas; and**
- **Good combustion practices.**

4.5.4 BACT Analysis for CO Emissions from Emergency Equipment (AA-501)

Emergency Equipment – Includes the following:

- Diesel-Fired Emergency Generator (1 rated at 670-HP): 0.7 tpy CO.

Step 1 – Identify Control Options

There are no control options identified in the RBLC that are technically feasible to control CO that is emitted from emergency equipment. See below table for summary of CO BACT determinations from the RBLC database:

Step 2 - Technical Feasibility of CO Control Alternatives

The emergency diesel fired generator will be used primarily for emergency situations, if any. However, to maintain the integrity of the equipment, the generator will be operated for less than 100 hours per year. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank Remaining Alternatives by Control Effectiveness

The most effective method for control of CO emissions from operation of the emergency fuel combustion devices is the use of fuel specifications that employ clean burning fuels, implementation of good combustion practices and use of combustion controls inherent to the design of the individual combustion devices.

Step 4 - Evaluate Most Effective Controls

Since there are no other feasible technologies to control CO emissions from the emergency generator, economic, energy and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

The following table lists the existing CO BACT determinations for diesel fired emergency generators. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Facility/ RBLC ID	Permit Date	Process	CO BACT Limit	Add-On Controls
Southeast Renewable Fuels (FL-0322)	12/23/10	Emergency ULSD Generators (two 2,682 HP)	3.5 G/KW-H	No controls The emergency generators shall comply with the emission limit and demonstrate compliance in accordance with the procedures given in NSPS 40 CFR 60, Subpart IIII.
Idaho Power Company ID-0018	6/25/10	750 KW Emergency Diesel Generator	3.5 G/KW-H	Tier 2 Engine, Good combustion practices

Facility/ RBLC ID	Permit Date	Process	CO BACT Limit	Add-On Controls
Consumers Energy (MI-0389	12/29/09	2000 KW Emergency ULSD Generator	3.5 G/KW-H	Engine design and operation
Verenium (FL-0318)	12/10/09	2000 KW Emergency generators	3.5 G/KW-H	None
Lake Charles Cogeneration, LLC (LA-0231)	06/22/09	Emergency Diesel Power Generator Engines (1341 HP)	0.62 lb/h	Comply with 40 CFR 60 Subpart IIII
Southeast Idaho Energy, LLC (ID-0017)	2/10/09	2 MW Emergency Generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII, limited to 100 hours of operation per year
		500 KW emergency generator	Comply with NSPS IIII	Good combustion practices, EPA certified per NSPS IIII, limited to 100 hours of operation per year
Associated Electric Cooperative Inc (OK-0129)	1/23/09	2200 HP low sulfur diesel emergency generator	3.5 G/KW-H	None

As shown in the table above, BACT for the emergency equipment has been determined to be compliance with NSPS IIII and good combustion/operating practices

Step 5 – Select BACT for CO from Emergency Equipment

BACT for CO emissions from the emergency equipment is proposed as:

- **Compliance with NSPS IIII; and**
- **Good combustion/operating practices.**

4.6 Best Available Control Technology (BACT) Analysis - Emissions of SO_2

The BACT evaluation focuses on the control technologies that have been demonstrated and commercially available for control of SO_2 emissions. Because of the importance of controlling these emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes.

The source of SO_2 emissions is attributable to the sulfur content of the raw materials charged in the SAFs and from the sulfur content of the fuels to be combusted in supporting operations to be performed at the plant.

4.6.1 SO2 Emission Sources Subject to Control Technology Evaluation

The SO_2 emission sources associated with the proposed plant that are included in this SO_2 BACT evaluation are as follows:

- Semi-Enclosed Submerged Arc Furnaces;
- Natural gas fired combustion equipment; and
- Emergency equipment.

For a summary of the estimated SO_2 emission rates for the sources identified above, please refer to the following table:

SO_2 Emission Rates for Sources Evaluated for BACT

Equipment Description	SO_2 Emission Rate (tons/year)
Semi-Enclosed Submerged Arc Furnace	2169.7
Natural Gas Combustion Equipment • Ladle preheaters	0.10
Emergency Equipment: • Emergency Generator	0.27
Total	2170.0

4.6.2 BACT Analysis for SO_2 Emissions from Semi-Enclosed Submerged Arc Furnaces (AA-201)

Step 1 – Identify Control Options

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling SO_2 emissions from plant operations:

1. On-line USEPA Control Technology Database;
2. State Air Quality Permits; and
3. Control Technology Vendors.

The following control technologies were identified and evaluated to control SO_2 emissions from the SAFs:

(a) Lower-Sulfur Charge Substitution; and

(b) Flue Gas Desulfurization (FGD) options:

(1) Wet Scrubbing;

(2) Spray Dryer Absorption (SDA); and

(3) Dry Sorbent Injection (DSI).

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing SO_2 emissions from the SAFs. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(a) Lower-Sulfur Charge Materials - Substitution with lower sulfur-bearing raw materials is technically feasible and will be included in this analysis. A summary of the charge materials and sulfur content of the materials, are described below.

Coal - The Department of Energy estimates that the use of the lowest sulfur coal can result in up to 85 percent lower SO_2 emissions than the use of many types of higher sulfur coal[8]. In the U.S., coal from eastern states including Ohio, Pennsylvania, and West Virginia has higher sulfur content, accounting for 3 to 10 percent of the coal's weight; coal from western states such as Wyoming, Montana, Utah, and Colorado can have sulfur contents that make up less than 1 percent of its weight[9]. However, low-sulfur coal is significantly more expensive

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[8] ↑ Annual Energy Outlook 2002 with Projections to 2020, US Department of Energy, January 2002

[9] Cleaning up Coal, U.S. Department of Energy

than higher sulfur coal, and often incurs additional transportation costs. MS Silicon will work to utilize the lowest cost effective, available coal source. The success of the plant is to produce a high quality silicon product that is cost competitive within the industry. MS Silicon will be utilizing a best available SAF and supporting equipment to:

1) Produce a cost competitive product;
2) Minimizes emissions of regulated air pollutants; and
3) Utilize good combustion practices and operating equipment to minimize the plant's energy/GHG footprint.

Wood - The low sulfur content of wood (0.007 to 0.08% by weight sulfur) minimizes SO_2 emissions

(b) Flue Gas Desulfurization –

FGD systems currently in use for SO_2 abatement can be classified as wet and dry systems. Based on a review of the RBLC database and state permits, it was revealed that control technologies for SO_2 abatement have not been implemented for SAFs. However, FGD options which have been traditionally applied to utility boilers may be available to control SO_2 from the SAFs. Therefore, the application of these technologies to the SAFs will be examined further.

The suitability of gas absorption as a pollution control method is generally dependent on the following factors:

1) Availability of suitable solvent;
2) Required removal efficiency;
3) Pollutant concentration in the inlet vapor;
4) Capacity required for handling waste gas; and,
5) Recovery value of the pollutant(s) or the disposal cost of the spent solvent.

Gas absorbers are most widely used to remove water soluble inorganic contaminants from air streams with typical pollutant concentrations ranging from 250 to 10,000 ppmv.[10] The SO_2 concentration from the proposed SAFs has been estimated at 8 ppm. For FGD controls in general, the expected variability and low SO_2 concentrations in the gas stream are not amenable to FGD which is typically geared for high sulfur fuel combustion systems.

(1) Wet Scrubbing -- Wet scrubbers are regenerative processes which are designed to maximize contact between the exhaust gas and an absorbing liquid. The exhaust gas is

[10] SO_2 and Acid Gas Controls, Sixth Edition, EPA/452/B-02-001

scrubbed with a 5 - 15 percent slurry, comprised of lime (CaO) or limestone ($CaCO_3$) in suspension. The SO_2 in the exhaust gas reacts with the CaO or $CaCO_3$ to form calcium sulfite ($CaSO_3.2H_2O$) and calcium sulfate ($CaSO_4$). The scrubbing liquor is continuously recycled to the scrubbing tower after fresh lime or limestone has been added.

The types of scrubbers which can adequately disperse the scrubbing liquid include packed towers, plate or tray towers, spray chambers, and venturi scrubbers. In addition to calcium sulfite/sulfate, numerous other absorbents are available including sodium solutions and ammonia-based solutions[11].

There are various potential operating problems associated with the use of wet scrubbers. First, particulates are not acceptable in the operation of wet scrubbers because they would plug spray nozzles, packing, plates and trays. Thus, the scrubber would have to be located downstream of the SAFs baghouses. This would substantially increase the capital cost of the wet scrubber, which is typically two to three times more expensive than the capital cost for a dry scrubber. Wet scrubbers also require handling, treatment, and disposal of a sludge by-product. In this case, air emissions would be exchanged for a large-scale water pollution problem. Treatment of wet scrubber wastes requires advanced wastewater treatment including frequent maintenance by an experienced operator. The SO_2 concentration will vary widely over the SAFs cycle which operates as a batch process. This will preclude efficient application of wet scrubbing. Thus, the wet scrubber option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(2) Spray Dryer Absorption (SDA) -- An alternative to wet scrubbing is a process known as dry scrubbing, or spray-dryer absorption (SDA). As in wet scrubbing, the gas-phase SO_2 is removed by intimate contact with a suitable absorbing solution. Typically, this may be a solution of sodium carbonate (Na_2CO_3) or slaked lime [$Ca(OH)_2$]. In SDA systems the solution is pumped to rotary atomizers, which create a spray of very fine droplets. The droplets mix with the incoming SO_2-laden exhaust gas in a very large chamber and subsequent absorption leads to the formation of sulfites and sulfates within the droplets. Almost simultaneously, the sensible heat of the exhaust gas which enters the chamber evaporates the water in the droplets, forming a dry powder before the gas leaves the spray dryer. The temperature of the desulfurized gas stream leaving the spray dryer is now approximately 30 - 50 ^{o}F above its dew point.

The exhaust gas from the SDA system contains a particulate mixture which includes reacted products. Typically, baghouses employing Teflon-coated fiberglass bags (to minimize bag corrosion) are utilized to collect the precipitated particulates.

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[11] SO_2 and Acid Gas Controls, Sixth Edition, EPA/452/B-02-001

The SDA process would not have many of the potential operating problems associated with the wet scrubbing systems. The SO_2 concentration will vary widely over the SAFs cycle. Thus, SDA dry scrubbing option is considered technically infeasible for this application and will be not be considered any further in this BACT analysis.

(3) Dry Sorbent Injection (DSI) -- This control option typically involves the injection of dry powders into either the furnace or post-furnace region of utility-sized boilers. This process was developed as a lower cost option to conventional FGD technology. Since the sorbent is injected directly into the exhaust gas stream, the mixing offered by the dry scrubber tower is not realized.

The dry sorbent injection process would not have many of the potential operating problems associated with the wet scrubbing systems. The SO_2 concentration will vary widely over the SAFs cycle. The injection dose of sorbent materials would be hard to control in order to match variability in SO_2 concentrations. Similar control systems are fraught with chronic operational problems with the sensors requiring frequent maintenance and calibration.

Thus, DSI dry scrubbing option is considered technically infeasible for this application and will be not be considered any further in this BACT analysis.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

All control alternatives identified in Step 2 were eliminated as not technically feasible for controlling SO_2 emissions from the silicon production operations, with the exception of lower sulfur charge and good operating combustion practices.

Step 4 – Evaluate the Most Effective Controls and Document Results

Lower sulfur charge and good operating combustion practices were the only technically feasible control option in controlling SO_2 emissions from the SAF.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for submerged arc furnaces or any other sources associated with the silicon production operations. Review of state permit information identified the following with respect to submerged electric arc furnaces at silicon production plants:

Facility/	Permit Date	Process	SO_2 Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009	11/26/10	Two submerged-arc semi-enclosed-type electric furnaces (22 MW/hr)	Coke which exceeds the 1.7 lb/million Btu maximum and 1.4 lb/million Btu consecutive three month average, sulfur in fuel limits of 6NYCRR, Part 225-1.2 (d) Table 2 for solid fuel, may be used in combination with coal in the furnace charge on a minimum 4:1 coal/coke ratio. Globe is required to demonstrate that when using coke with a sulfur content greater than the allowable limit in combination with coal, the sulfur dioxide emissions will not exceed a maximum 3.4 pounds of sulfur dioxide per million Btu heat input and an average 2.8 pounds of sulfur dioxide per million Btu heat input. No control	
Globe Metallurgical Selma, AL 104-0001	9/10/10	20 MW Electric Arc Furnaces (2) producing silicon metal	SO_2: 94 lb/hr Capacity: 20 MW/hr SO_2: 4.95 bs/MW	No control
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006	01/18/06	Electric submerged arc furnace No. 15 for the production of silicon metal and ferroalloys	SO_2: 68.7 b/hr Nominal Capacity: 2 tons/hr SO_2: 34.35 lbs/ton silicon	No controls
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105	10/24/01	Electric Arc Furnaces (Ferrosilicon and Silicon metal production furnaces)	None	No controls

As shown in the above table, SO_2 emissions from SAFs are uncontrolled. None of the sources as reflected in the above table have proposed or successfully implemented any add-on control devices to control SO_2 emissions from SAFs operation.

MS Silicon is proposing the SO_2 BACT for the SAFs as follows:

- **Total SO_2 emissions from the SAF shall be limited to 52 lbs/ton (averaged over a 30-day period) of silicon produced; and**

- **Utilization of low sulfur content material, where technically feasible.**

4.6.3 BACT Analysis for SO_2 Emissions from Natural Gas Combustion (AA-202)

Natural Gas Combustion Sources – Includes the following:

- Ladle Pre-Heaters (4 – 10.0 MMBtu/hr): 0.10 tpy $SO_{2;}$

Step 1 – Identify Control Options, Step 2 – Eliminate Technically Infeasible Control Options, Step 3 – Rank Remaining Control Technologies by Control Effectiveness and Step 4 – Evaluate the Most Effective Controls and Document Results

There are no control options identified in the RBLC that are technically feasible to control SO_2 that is emitted at from small natural gas combustion units. See below table for summary of SO_2 BACT determinations from the RBLC database:

Facility/ RBLC ID	Permit Date	Basis	Process	SO_2 BACT Limit	Controls
Lake Charles Cogeneration LLC LA-0231	06/22/09	BACT-PSD	34.20 MMBtu/hr Shift Reactor Startup Heater	0.0006 b/MMBtu	Combustion of natural gas
Competitive Power Ventures MD-0040	11/12/08	BACT-PSD	1.70 MMBtu/hr Heater	No limit	Exclusive use natural gas with sulfur content not to exceed 2.0 gr/100 scf
Mid-American Steel and Wire Company OK-0128	09/08/08	BACT-PSD	13.30 MMBtu/hr Ladle Preheater and refractory drying	0.0006 b/MMBtu	Combustion of natural gas
Thysenkrupp Steel and Stainless USA, LLC AL-0230	08/17/07	BACT PSD	33.40 MMBtu/hr Batch Annealing Furnaces	0.0006 b/MMBtu	No control
Nucor Steel AR-0090	04/03/06	BACT-PSD	Ladle Dryer	0.0006 b/MMBtu	No control

Facility/ RBLC ID	Permit Date	Basis	Process	SO_2 BACT Limit	Controls
Republic Engineered Products, Inc OH-0303	08/30/05	LAER	14.5 MMBtu/hr Ladle Dryers/Preheaters	0.0006 b/MMBtu	Use of natural gas with sulfur content less than 0.6 % by weight
Charter Steel OH-0276	06/10/04	BACT-PSD	10 MMBtu/hr Ladle Preheater and Dryer, 4 Units	0.0006 b/MMBtu	No controls
Nucor Steel IN-0090	01/19/01	BACT-PSD	15 MMBtu/hr Ladle Preheaters	No limit	Combustion of natural gas or propane

As shown in the above table, no add-on controls are used for SO_2 from the small natural gas combustion equipment.

Step 5 - Select BACT

The RACT/BACT/LAER Clearinghouse (RBLC) and review of other permits reveal that similar small natural gas combustion devices use fuel specifications and good combustion practices for controlling SO_2 emissions. No similar sized natural gas combustion devices were identified add-on SO_2 controls as BACT.

Thus, BACT is defined as combustion of clean fuel and good combustion practices. For the natural gas combustion sources associated with the proposed Plant, combustion of natural gas and good combustion controls were the only control methods evaluated. Since the highest level of SO_2 control as noted above will be implemented by MS Silicon, an analysis of economic, energy and environmental impacts was not performed.

Thus, BACT for SO_2 emissions from natural gas combustion equipment to be utilized at the plant is defined as:

- **SO_2 emission rate of 0.0006 lbs/MMBtu;**
- **Combustion of clean fuel; and**
- **Good combustion practices.**

4.6.4 BACT Analysis for SO_2 Emissions from Emergency Equipment (AA-501)

Emergency Equipment – Includes the following:

- Diesel-Fired Emergency Generator (1 rated at 670-HP each): 0.2 tpy SO_2

Step 1 – Identify Control Options

There are no control options identified in the RBLC that are technically feasible to control SO_2 that is emitted at from emergency equipment. See below table for summary of SO_2 BACT determinations from the RBLC database:

Step 2 - Technical Feasibility of SO_2 Control Alternatives

The emergency diesel generator will be used primarily for emergency situations, if any. However, to maintain the integrity of the equipment, the generator will be operated for 100 hours per year or less. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank Remaining Alternatives by Control Effectiveness

The most effective method for control of SO_2 emissions from operation of the emergency fuel combustion devices is the use of fuel specifications that employ clean burning fuels, implementation of good combustion practices and use of combustion controls inherent to the design of the individual combustion devices.

Step 4 - Evaluate Most Effective Controls

Since there are no other feasible technologies to control SO_2 emissions from the emergency equipment, economic, energy and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

The following table lists the existing SO_2 BACT determinations for diesel fired emergency equipment. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Facility/ RBLC ID	Permit Date	Process	SO_2 BACT Limit	Controls
Southeast Renewable Fuels (FL-0322)	12/23/10	Emergency ULSD Generators (two 2,682 HP)	No limit	No controls Engines will fire ULSD fuel oil or propane and each will be limited to 500 hours per year of operation during emergencies.

Facility/ RBLC ID	Permit Date	Process	SO_2 BACT Limit	Controls
Idaho Power Company ID-0018	6/25/10	Emergency Diesel Generator	No limit	Tier 2 Engine, Good combustion practices
Consumers Energy (MI-0389	12/29/09	Emergency ULSD Generator	No limit	ULSD combustion, 500 hours of operation per year
Verenium (FL-0318)	12/10/09	Emergency generators	0.0015 % S	Comply with applicable provisions of 40 CFR 60, Subpart IIII
Lake Charles Cogeneration, LLC (LA-0231)	06/22/09	Emergency Diesel Power Generator Engines (1341 HP)	0.0100 lb/hr	Comply with 40 CFR 60 Subpart IIII
Southeast Idaho Energy, LLC (ID-0017)	2/10/09	2 MW Emergency Generator	No limit	100 hours of operation per year, ULSD fuel, good combustion practices, EPA certified per NSPS IIII
		500 KW emergency generator	No limit	100 hours of operation per year, ULSD fuel, good combustion practices, EPA certified per NSPS IIII
Associated Electric Cooperative Inc (OK-0129)	1/23/09	2200 HP low sulfur diesel emergency generator	0.89 lb/hr	Low sulfur diesel fuel < 0.05% S

As shown in the table above, BACT for the emergency equipment is compliance with NSPS IIII; good combustion/operating practices, and the use of ultra-low sulfur diesel (ULSD) fuel.

Step 5 – Select BACT for SO_2 from Emergency Equipment

BACT for SO_2 emissions associated with the emergency equipment is proposed as compliance with NSPS IIII; good combustion/operating practices, and use of ULSD.

4.7 Best Available Control Technology (BACT) Analysis - Emissions of VOC

The BACT evaluation focuses on the control technologies that have been demonstrated and commercially available for control of VOC emissions. Because of the importance of controlling these emissions, MS Silicon evaluated technologies that have been demonstrated on similar processes.

4.7.1 VOC Emission Sources Subject to Control Technology Evaluation

The VOC emission sources associated with the proposed plant that are included in this VOC BACT evaluation are as follows:

- Semi-Enclosed Submerged Arc Furnaces;
- Natural gas fired combustion equipment; and
- Emergency equipment.

For a summary of the estimated VOC emission rates for the sources identified above, please refer to the following table:

VOC Emission Rates for Sources Evaluated for BACT

Equipment Description	VOC Emission Rate (tons/year)
Semi-Enclosed Submerged Arc Furnaces	92.5
Natural Gas Combustion Equipment • Ladle preheaters	0.9
Emergency Equipment: • Emergency Generator	0.08
Total	93.5

4.7.2 BACT Analysis for VOC Emissions from Semi-Enclosed Submerged Arc Furnaces (AA-201)

Step 1 – Identify Control Options

The first step of the Top-Down BACT analysis is to assess the proposed emission reduction options. The sources of information on emission reduction options vary for the air emission sources being analyzed. The following information resources were consulted in searching for the alternatives available for controlling emissions from the semi-enclosed submerged electric arc furnaces:

1. On-line USEPA Control Technology Database; and
2. State Air Quality Permits

The following control technologies were identified and evaluated to control VOC emissions from the SAFs:

(a) Operating Practice Modifications;

(b) Flaring of VOC Emissions;

(c) VOC Oxidation Catalysts;

(d) Post-Combustion Reaction Chamber;

(e) Catalytic Incineration; and

(f) Oxygen Injection.

Step 2 – Eliminate Technically Infeasible Control Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing VOC emissions from the SAF. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative. MS Silicon is also proposing to utilize a semi-enclosed SAF design that will reduce the quantity of VOC generated during the furnace conversion process. Because of the nature of the furnace process and temperatures that will be achieved during the process, engineering literature suggests VOC emissions will be minimal. For purposes of this application we have conservatively assumed VOCs will be generated and have assigned an emission factor expressed in lbs/ton.

(a) Operating Practice Modifications -- Due to marketplace demands on the type of products to be manufactured and the required product quality, MS Silicon does not propose any additional operating practice modifications that will alter VOC emissions from the existing SAF. Therefore, this control option will be eliminated for further evaluation in this BACT analysis.

(b) Flaring of VOC Emissions -- Based upon a review of the previously listed information resources, there is no known application of flaring SAF exhaust gases. Flaring of emissions for VOC destruction would require raising the exhaust gas temperature. Thus, based on the relatively large gas volumetric flow at a substantial temperature differential, the auxiliary fuel requirements needed to operate the flare would be overwhelmingly large. Additionally, it can be speculated as to whether the flare would actually result in a decrease of VOC emissions or increase thereof from supplemental fuel combustion, which would also result in an increase of NO_x emissions and potential CO_2 emissions. Consequently, this control alternative is considered technically infeasible for SAF exhausts and thus, will not be considered any further in this BACT analysis.

(c) VOC Oxidation Catalysts -- Based upon a review of the previously listed information resources, there is no known application of VOC oxidation catalysts to control VOC emissions from a SAF. The optimal working temperature range for VOC oxidation catalysts is approximately 850 ^{o}F - 1,100 ^{o}F with a minimum exhaust gas stream temperature of 500 ^{o}F for minimally acceptable VOC control. Exhaust gases from the SAF will undergo rapid cooling as they are ducted from the furnace. Thus, the temperature will be far below the minimum 500 ^{o}F threshold for effective operation of VOC oxidation catalysts. Additionally, the particulate loading in the exhaust gas stream is anticipated to be too high for efficient operation of a VOC oxidation catalyst. Masking effects such as plugging and coating of the catalyst surface would almost certainly result in impractical maintenance requirements, and would significantly degrade the performance of the catalyst. Consequently, this control alternative is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(d) Post-Combustion Reaction Chambers -- Based upon a review of the previously listed information resources, there is no known successful application of duct burners or thermal incinerators to control VOC emissions from silicon production operations. The feasibility of these units to effectively reduce VOC emissions, without resulting in severe operational problems, is unknown. Further, such units are expected to consume large quantities of natural gas and oxygen; resulting in excessive annual operating costs.

The principle of destruction within post combustion chambers is to raise the SAF exhaust gases to a sufficiently high temperature and for a minimum amount of time to facilitate oxidation. The combustion chamber configuration must provide effective mixing within the chamber with an acceptable residence time. Recuperative heat exchangers can be used with these systems to recover a portion of the exiting exhaust gas heat and reduce the auxiliary fuel consumption.

The amount of VOC which could be oxidized with post combustion systems is uncertain, and precise performance guarantees are expected to be difficult to obtain from equipment manufacturers because of the lack of operating experience. In addition, there is the potential for additional emissions of NO_x and CO_2 from auxiliary fuel combustion. Further, due to the heat and particulate loading, the burners would have a short life expectancy, and may sustain severe maintenance and reliability problems. Additionally, a single or multiple duct burner system would not be able to heat the relatively cool gases from the SAF during cold cycling. Potentially, there are two locations where post combustion chambers can be installed, i.e., upstream or downstream of an SAF baghouse. Locating upstream of the baghouse would take advantage of slightly elevated temperatures in the exhaust gas stream. However, at this location, the post combustion chamber would be subject to high particulate loading. The units would be expected to foul frequently from the particulate accumulation, and the burners would have severe maintenance and reliability problems. Thus, the installation of the post combustion chamber upstream of the baghouse is considered technically infeasible. Alternatively, the post combustion chamber could be installed downstream of the SAF baghouse. However, even at this location, fouling due to particulate matter can occur and more importantly, even cooler exhaust temperatures would be encountered. These cooler temperatures would greatly increase the auxiliary fuel requirements. Further, the combustion of additional fuel will result in increases in emissions to the atmosphere.

Based upon the above discussions, the use of a post combustion chamber is considered technically infeasible for the silicon production operations and will not be considered any further in this BACT analysis.

(e) Catalytic Incineration -- Based upon a review of the previously listed information resources, there is no known application of catalytic incineration to control VOC emissions from silicon production operations. Catalytic incinerators use a bed of catalyst that facilitates the overall combustion of combustible gases. The catalyst increases the reaction rate and allows the conversion of CO to CO_2 at lower temperatures than a thermal incinerator. The catalyst is typically a porous noble metal material which is supported in individual compartments within the unit. An auxiliary fuel-fired burner ahead of the bed heats the entering exhaust gases to 500 ^oF – 600 ^oF to maintain proper bed temperature. Recuperative heat exchangers are used to recover the exiting exhaust gas heat and reduce the auxiliary fuel consumption. Secondary energy recovery is typically 70 percent.

Catalytic incineration systems are limited in application due to potential poisoning, deactivation, and/or blinding of the catalyst. Lead, arsenic, vanadium, and phosphorus are generally considered poisons to catalysts and deactivate the available reaction sites on the catalyst surface. Particulate can also build up on the catalyst, effectively blocking the porous catalyst matrix and rendering the catalyst inactive. In cases of significant levels of poisoning compounds and particulate loading, catalyst replacement costs are significant.

As in the thermal incineration discussion, potentially, there are two locations where the incinerator can be installed, i.e., upstream or downstream of the SAF baghouse. For the same reasons discussed earlier (e.g., fouling due to particulate matter), the upstream location is considered technically infeasible. Alternatively, the incinerator can be installed downstream of the meltshop baghouse. However, even at this location, fouling due to particulate matter can occur, and further, the exhaust will be at a lower temperature. These cooler temperatures would greatly increase the auxiliary fuel requirements. The associated combustion of additional auxiliary fuel will result in an unacceptable increase in operating costs. Further, the combustion of additional fuel will result in increases in emissions to the atmosphere.

Due to the lack of application of catalytic incineration for SAFs and potentially adverse technology applicability issues, this control alternative is considered technically infeasible and will not be considered any further in this BACT analysis.

Step 3 – Rank Remaining Control Technologies by Control Effectiveness

All control alternatives identified in Step 2 were eliminated as not technically feasible for controlling VOC emissions from the SAF.

Step 4 – Evaluate the Most Effective Controls and Document Results

Good operating practices are only technically feasible control option in controlling VOC emissions from the SAF.

Step 5 – Select BACT

A review of USEPA's RACT/BACT/LAER Clearinghouse did not identify any BACT determinations for submerged arc furnaces or any other sources associated with the silicon production operations. Review of state permit information identified the following with respect to submerged electric arc furnaces at silicon production plants:

Facility/ RBLC ID	Permit Date	Process	VOC Limit	Add-On Controls
Globe Metallurgical Inc Niagara Falls, NY Permit#: 9-2911-00078/00009	11/26/10	Two submerged-arc semi-enclosed-type electric furnaces (22 MW/hr)	No limit	No control
Globe Metallurgical Selma, AL 104-0001	9/10/10	20 MW Electric Arc Furnaces (2) producing silicon metal	VOC: 5.7 lb/hr Capacity: 20 MW/hr VOC: 0.29 lbs/MW	No control
West Virginia Alloy, Inc. Alloy, West Virgina R30-01900001-2006	01/18/06	Electric submerged arc furnace No. 15 for the production of silicon metal and ferroalloys	VOC: 4.15 lb/hr Nominal Capacity: 2 tons/hr	No controls
Globe Metallurgical Inc Waterford, OH ID: 06-84-00-0105	10/24/01	Electric Arc Furnaces (Ferrosilicon and Silicon metal production furnaces)	None	No controls

As shown in the above table, VOC emissions from submerged electric arc furnaces are uncontrolled. None of the sources as reflected in the above table have proposed or successfully implemented any add-on control devices to control VOC emissions from SAF operation.

MS Silicon is proposing the BACT for VOC from the SAFs as follows:

- **Good operating practices; and**
- **Total VOC emissions from the SAF shall be limited to 2.4 lbs/ton (averaged over a 30-day period) of silicon produced.**

4.7.3 BACT Analysis for VOC Emissions from Natural Gas Combustion (AA-202)

Natural Gas Combustion Sources – Includes the following:

- Ladle Pre-Heaters (4 – 100 MMBtu/hr): 0.9 tpy VOC;

Step 1 – Identify Control Options, Step 2 – Eliminate Technically Infeasible Control Options, Step 3 – Rank Remaining Control Technologies by Control Effectiveness and Step 4 – Evaluate the Most Effective Controls and Document Results

There are no control options identified in the RBLC that are technically feasible to control VOC that is emitted in small quantities from each combustion unit. See below table for summary of VOC BACT determinations from the RBLC database:

Facility/ RBLC ID	Permit Date	Basis	Process	VOC BACT Limit	Controls
Mid-American Steel and Wire Company OK-0128	09/08/08	BACT-PSD	Ladle Preheater and refractory drying	0.0055 lb/MMBtu (total)	Combustion of natural gas
Nucor Steel AR-0090	04-03/06	BACT-PSD	Ladle Dryer	0.0006 lb/MMBtu	Good combustion practice
Republic Engineered Products, Inc OH-0303	08030/05	LAER	Ladle Dryers/Preheaters	5.5 lb/mmscf	Best operational and engineering practices, good combustion practices
Charter Manufacturing Co. Inc. Charter Steel OH-0276	06/10/04	BACT-PSD	Ladle Preheater and Dryers	0.005 lb/MMBtu	No controls

As shown in the above table, no add-on controls are used for VOC control from the small natural gas combustion equipment at ferroalloy facilities.

Step 5 - Select BACT

The RACT/BACT/LAER Clearinghouse (RBLC) and review of other permits reveal that similar natural gas combustion devices use fuel specifications and good combustion practices for controlling VOC emissions. No similar sized natural gas combustion devices were identified as using add-on VOC controls as BACT.

Thus, BACT is defined as combustion of clean fuel and good combustion practices. For the natural gas combustion sources associated with the proposed plant, combustion of natural gas and good combustion controls were the only control methods evaluated. Since the highest level of VOC control as noted above will be implemented by MS Silicon, an analysis of economic, energy and environmental impacts was not performed.

BACT for the VOC emissions from small natural gas combustion devices to be used to support the silicon manufacturing processes is as follows:

- **Combustion of natural gas;**
- **Good operating practices; and**
- **Total VOC emission limit of 0.0055 lb/MMBtu (AP-42 Emission Factor).**

4.7.4 BACT Analysis for VOC Emissions from Emergency Equipment (AA-501)

Emergency Equipment – Includes the following:

- Diesel-Fired Emergency Generator (1 rated at 670-HP each): 0.27 tpy VOC.

Step 1 – Identify Control Options

There are no control options identified in the RBLC that are technically feasible to control VOC that is emitted at from each piece of emergency equipment. See below table for summary of VOC BACT determinations from the RBLC database:

Step 2 - Technical Feasibility of VOC Control Alternatives

The emergency diesel generator will be used primarily for emergency situations, if any. However, to maintain the integrity of the equipment, the generator will be operated for 100 hours per year or less. Based on a review of similar emission sources, these emission sources typically do not have any add-on controls and should be operated per manufacturer's specifications.

Step 3 - Rank Remaining Alternatives by Control Effectiveness

The most effective method for control of VOC emissions from operation of the emergency fuel combustion devices is the use of fuel specifications that employ clean burning fuels, implementation of good combustion practices and use of combustion controls inherent to the design of the individual combustion devices.

Step 4 - Evaluate Most Effective Controls

Since there are no other feasible technologies to control VOC emissions from the emergency equipment, economic, energy and environmental impact analyses were not performed, nor are required by USEPA's Top-Down approach.

The following table lists the existing VOC BACT determinations for diesel fired emergency equipment. All data in the table is based on the information obtained from the U.S. EPA RACT/BACT/LAER Clearinghouse (RBLC), and electronic versions of permits available at the websites of other permitting agencies.

Facility/ RBLC ID	Permit Date	Process	VOC BACT Limit	Add-On Controls
Idaho Power Company ID-0018	6/25/10	750 KW Emergency Diesel Generator	6.4 G/KW-H	Tier 2 Engine, Good combustion practices
Consumers Energy (MI-0389)	12/29/09	2000 KW Emergency ULSD Generator	6.4 G/KW-H	Engine design and operation
Verenium (FL-0318)	12/10/09	2000 KW Emergency generators	6.4 G/KW-H	The emergency generator and fire pumps are both an Emergency Stationary Compression Ignition Internal Combustion Engine (Stationary ICE) and shall comply with applicable provisions of 40 CFR 60, Subpart IIII
		Emergency ULSD Fired Pump	3.0 g/hp-hr	
Associated Electric Cooperative Inc (OK-0129)	1/23/09	2200 HP low sulfur diesel emergency generator	1.55 lb/hr	Good combustion practices
		267 HP low sulfur diesel emergency fir pump	0.66 lbs/hr	Good combustion practices

As shown in the table above, BACT for the emergency equipment is compliance with NSPS IIII and good combustion/operating practices

Step 5 – Select BACT for VOC from Emergency Equipment

BACT for VOC emissions from the emergency equipment is proposed as:

- **Compliance with NSPS IIII; and**
- **Good combustion/operating practices.**

4.8 Summary of BACT Evaluation

As shown in this BACT evaluation, BACT is being proposed for each regulated air pollutant associated with the equipment/operations at the proposed plant. The emission limitations provided in Tables 4-1 through 4-6 represent BACT taking into account BACT limits established for recently permitted similar operations.

Section 5: Air Quality Impact Evaluation

As stated in the Code of Federal Regulations (40 CFR 52) and MDEQ rule APC-S-5, any application for a permit under the PSD provisions shall contain an analysis of ambient air quality in the area that the major project would affect. This requirement only applies to those air pollutants that would trigger PSD applicability (i.e., PSD review).

The proposed plant will be subject to PSD review for emissions of $PM_{10,}$ $PM_{2.5}$, NO_x, CO and SO_2. It is therefore necessary to determine if the proposed plant will have a significant impact on ambient air quality, defined by predicted impacts in excess of a Significant Impact Level (SIL). If the proposed plant has a significant impact on ambient air quality, then a demonstration of compliance with the National Ambient Air Quality Standards (NAAQS) and the Prevention of Significant Deterioration (PSD) Class II increments will be performed for those pollutants that have a significant impact on ambient air quality. The following subsections present the air quality impact analysis for emissions of $PM_{10,}$ $PM_{2.5}$, NO_x, CO and SO_2 as a result of the proposed plant.

An ozone impact analysis is required if VOC emissions from the proposed plant are more than 100 tons/year. Since VOC emissions from the proposed plant will be below 100 tons/year, an air quality impact evaluation is not required, which is consistent with federal and state PSD requirements.

A detailed description of the modeling approach and data requirements for the assessment of air quality impacts due to the proposed plant is included in this section. Currently, the analyses to estimate whether or not the project will have impacts in excess of the SILs or in excess of the Significant Monitoring Concentrations (SMCs) have been completed. It is our understanding that this project will be the first PSD permit in Tishomingo County. As a result, for each air pollutant that results in a significant impact, the corresponding PSD minor source date will be triggered. Subsequently, the proposed plant will be the only PSD Class II Increment consuming source. The results obtained from evaluating compliance with the PSD Class II Increments are provided as part of this application. Any required multisource impact analyses for demonstration of compliance with the NAAQS are pending. The results of such multisource impact analyses will be provided as an addendum to this document in the near future.

5.1 Selected Air Dispersion Model for the Project

The most recent version of the U.S. EPA regulatory model AERMOD (Version 11103), developed by The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) was utilized for this project. Regulatory default options available in the model will be used for the compliance demonstrations.

BREEZE AERMOD was used to prepare the input for and process the output from AERMOD. BREEZE AERMOD provides a graphical interface with geographic information system (GIS) capabilities to enhance the AERMOD model and aid the user with setting up the AERMOD input file and organizing and evaluating AERMOD output files. The U.S. EPA's approved regulatory AERMOD code which is used to predict ambient concentrations is unaltered by BREEZE AERMOD.

The AERMOD model family consists of several supporting pre-processor models. The following list summarizes the versions of AERMOD family software that were used for this air dispersion modeling analysis:

- AERMOD 11103;
- Building Profile Input Program for PRIME (BPIPPRM 04274); and
- AERMAP 11103.

5.2 Model Input and Support Data

Several data elements are required as input to support the dispersion model AERMOD, including:

- Representative hourly meteorological data;
- Potential points of predicted impacts, referred to as receptor points; and
- Terrain elevations for each individual receptor point.

Each of these data elements are discussed in the subsequent sections of this protocol.

5.3 Meteorological Data Selection and Pre-processing

MDEQ provides AERMOD View-ready meteorological (met) data sets consisting of five years of met data on their web site at the following url:

http://www.deq.state.ms.us/MDEQ.nsf/page/epd_AERMET_Preprocessedmetdata?OpenDocument

The North East Region met data set with surface data from the Tupelo Regional Airport and upper air data from Jackson provided by MDEQ is considered representative of the Project site. The met data was processed with AERMET View. The most recent five years of the met data, 2007 through 2011, was used for this air dispersion modeling project.

5.4 Coordinate System and Receptor Network

The AERMOD model objects were located using the Universal Transverse Mercator (UTM) coordinate system and North American Datum of 1983 (NAD83).

The receptor grid was designed to identify the maximum points of air quality impact due to the proposed plant and consisted of receptors extending to 50 kilometers from the proposed plant site. The ambient air boundary is defined by features which preclude public access from the plant site. Receptors were closely spaced (50 meters) along the proposed plant site's ambient air boundary to identify the influence of aerodynamic building downwash. The following receptor spacing was used for the receptor grid:

- 50-meter spacing along the ambient air boundary of the proposed plant site;

- 100-meter spacing from the proposed plant fence line to two kilometers out from the proposed plant site;
- 500-meter spacing from two kilometers to five kilometers from the proposed plant site;
- 1,000-meter spacing from five kilometers to ten kilometers from the proposed plant site; and
- 2,000-meter spacing from ten kilometers to fifty kilometers from the proposed plant site.

Figures 5-1 and Figure 5-2 present the receptor network used in the analysis.

5.5 Terrain Data Selection and Pre-processing

Terrain data was assigned to the receptor networks using the latest version of AERMAP (11103) and national elevation data (NED) files at 1-arc second resolution obtained from the United States Geological Survey (USGS) seamless data warehouse server. The elevation of buildings and sources on the site were based upon the planned finished grading of the site.

5.6 Project Emission Inventory

The emission inventory of the plant was based on the potential to emit emission rates provided in this air permit application to construct. The inventory is described in detail in Section 2.0 of this application with supporting backup calculations.

The emission inventory associated with the proposed plant is provided in Table 5-4, Table 5-5, and Table 5-6. AERMOD model objects – buildings, stacks, receptors on the fence line of the site – are depicted in Figure 5-3 and Figure 5-4.

5.7 Determination of the Significance of Project Contributions to Ambient Air Concentrations and Requirement for Pre-Construction Monitoring

The inventory of the proposed plant air emissions was modeled, and the predicted ambient air concentrations were compared with the PSD Class II SILs and the SMCs.

If the predicted concentrations are less than the SILs, the project is demonstrated to not cause or contribute to a violation of the NAAQS or PSD Class II Increments. If predicted concentrations exceed the SILs, further modeling is required to demonstrate that the project will not cause or contribute to a violation of the NAAQS or PSD Class II Increments. The significant impact area (SIA) is defined as the set of receptors at which predicted concentrations due to emissions from the plant are predicted to equal or exceed the SIL.

If the predicted concentrations are less than the SMCs, the plant will be exempt from the requirements to conduct pre or post construction monitoring under the PSD program. The statistical form of the modeled concentration is based on a 5-year National Weather Service met data set.

Tables 5-4a and 5-4b provides a summary of model predicted ambient air concentrations due to the plant and applicable SILs and SMCs. The statistical form of the modeled concentrations indicated in the footnotes of the table is based on a 5-year National Weather Service met data set. The predicted concentrations are appropriate for comparison with the SILs and SMCs.

The plant is predicted to contribute significantly to ambient air quality impacts for 24-hour and annual average PM_{10}, 24-hour and annual average $PM_{2.5}$, annual average, 1-hour, 3-hour and 24-hour SO_2, and 1-hour and annual average NO_2. The SIA distance for these criteria pollutants and averaging periods is provided in Tables 5-4a through 5-4d. Multisource impact analyses for each of these air pollutants to demonstrate compliance with the corresponding NAAQS is currently underway and will be provided to MDEQ as an addendum to this application under separate cover. The plant was predicted to result in predicted concentrations of emissions of CO below the 1-hour and 8-hour SILs, thus no multisource modeling analysis was required. The proposed plant will be below the corresponding NAAQS for emissions of CO.

5.8 Air Quality Monitoring

In addition to the requirement to conduct an air quality impact analysis, the PSD requirements also stipulate that an analysis be performed to assess ambient air quality for a pollutant in any area that the emission of that pollutant would affect.

To assess the ambient air quality from the proposed plant, an air quality impact assessment is typically performed and the predicted impacts are compared to the Significant Monitoring Concentration (SMC). However, for emissions of VOC, no SMC has been developed by USEPA.

If modeled concentrations are below the SMCs, then the requirement for pre- and post-construction monitoring is typically waived. Table 5-4b provides a comparison of the maximum predicted PM_{10}, $PM_{2.5}$, NO_2, SO_2, and CO concentrations, respectively, due to emissions from the proposed plant with the SMCs. Predicted PM_{10} and $PM_{2.5}$ concentrations are above the SMCs, and predicted $NO_{2,}$ CO and SO_2 concentrations are below the SMCs.

Based on past discussions with MDEQ, it was concluded that sufficient ambient monitoring has been performed throughout the state of Mississippi and that the requirement to conduct any preconstruction or post construction monitoring for emissions of PM_{10}, $PM_{2.5}$, NO_2, CO and SO_2 will not be required by MDEQ. Thus, the requirement to conduct ambient monitoring is being waived by MDEQ.

5.9 PSD Class II Increment Compliance Demonstration

The PM_{10}, $PM_{2.5}$, SO_2 and NO_2 PSD Class II increment compliance demonstrations did not require preparation of a multisource air modeling inventory because the MS Silicon project sources are the only PSD increment consuming source for these regulated air pollutants, being the first major source of these air pollutants to go through PSD review in the area since the increment was established. The results of the air dispersion modeling, which indicates that the MS Silicon plant will be in compliance with the PSD Class II increments, are provided in Table 5-4c.

5.10 NAAQS Compliance Demonstration

As mentioned in the introduction provided in Section 5.0, a multisource NAAQS analysis is currently ongoing. The results of that analysis will be provided to the MDEQ as an addendum to this application. It should be noted, as summarized in Table 5-4d, the proposed plant's emissions of regulated air pollutants will result in predicted concentrations below the NAAQS. As a result, the proposed plant will not cause an impact to human health and welfare.

Section 6: Additional Impact Analysis

The potential impact of the proposed silicon manufacturing plant's air pollutant emissions associated with construction and related growth are presented in this section. Assessment of the proposed plant's impact on soil, vegetation, and visibility are also presented in this section. A qualitative approach to these analyses was necessary for those areas in which analytical techniques are not well established.

6.1 Construction and Growth Impacts

The project being proposed by MS Silicon will have minimal effect on construction and growth impacts. During the construction phase, MS Silicon will employ various techniques to minimize the potential impact on the surrounding environment. The primary focus will be to reduce the formation of fugitive type particulates that may be generated during the construction phase.

The construction and operation of the proposed silicon manufacturing plant should not result in any noticeable residential growth in the area. Commercial growth is anticipated to occur at a gradual rate in the future. However, this growth will not be directly associated with the proposed plant in Tishomingo County.

6.2 Impact on Soil and Vegetation

The secondary NAAQS are intended to provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings from adverse effects of airborne pollutants. This protection extends to agricultural soil. As demonstrated in Section 5, predicted concentrations of PM_{10}, $PM_{2.5}$, NO_2, CO and SO_2 resulting from the proposed plant will not cause or contribute to a violation of the NAAQS. Since the secondary NAAQS were established to protect human welfare, no significant adverse impacts on soil are anticipated due to the proposed plant in Tishomingo County.

The effects of gaseous air pollutants on vegetation may be classified into three rather broad categories: acute, chronic, and long-term. Acute effects are those that result from relatively short (less than 1 month) exposures to high concentrations of pollutants. Chronic effects occur when organisms are exposed for months or even years to certain threshold levels of pollutants. Long-term effects include abnormal changes in ecosystems and subtle physiological alterations in organisms. Acute and chronic effects are caused by the gaseous pollutant acting directly on the organism, whereas long-term effects may be indirectly caused by secondary agents such as changes in soil pH.

NO_2 may affect vegetation either by direct contact of NO_2 with the leaf surface or by solution in water drops, becoming nitric acid. Acute and chronic threshold injury levels for NO_2 are much higher than those for SO_2.

The maximum predicted NO_2 ambient concentrations due to the proposed silicon manufacturing plant are below the ambient air quality standards, which are designed to protect public health and welfare from any known or adverse effect of air pollutants, including effects on vegetation.

6.3 Analysis of Endangered Species

Potential emissions of regulated criteria pollutants associated with the proposed plant are presented in Section 2.0 of this PSD air permit application. An air quality impact analysis was performed for emissions of PM_{10}, $PM_{2.5}$, NO_2, CO and SO_2. As shown in Section 5.0, emissions of PM_{10}, $PM_{2.5}$, NO_2, CO and SO_2 from the proposed plant will result in potential impacts below the NAAQS that protect human health and welfare.

MS Silicon's facility will be located in Tishomingo County, Mississippi. It is possible there may be endangered species located in Tishomingo County. However, as stated above, air emissions resulting from the proposed plant result in model predicted concentrations below the NAAQS. Therefore, these emissions are not expected to have a significant impact on endangered species which may be present in the county. In addition, maximum impacts from the proposed plant are in the immediate vicinity of the plant and it is unlikely due to the location of the proposed plant that endangered species would reside in these maximum impact areas. Table 6-1a presents the U.S. Fish & Wildlife Service's listing of threatened and endangered species in the State of Mississippi and Table 6-1b presents the list of threatened and endangered species in Tishomingo County.

6.4 Additional Air Quality Impact Analyses

As stipulated in the PSD regulations (40 CFR 52.21(o)) analysis of the impairment that would occur as a result of the proposed silicon manufacturing plant must be conducted. A discussion on this analysis as it relates to the proposed plant is provided below.

6.4.1 Impact on Visibility (Regional Haze Analysis)

As stated previously, the proposed plant will trigger applicability of the PSD regulations. One of the components of the PSD regulations includes the special protection of air quality and air quality related values (AQRV) at potentially affected nearby Class I areas. Assessment of the potential impact to visibility (regional haze analysis) is required if the source is located within 300 km of a Class I area. An evaluation may also be requested if the source's emissions are of sufficient size.

The nearest Class I area to the proposed plant site is identified below:

Class I Area	State	Approximate Distance (Project Site to Class I Area) (km)
Sipsey Wilderness Area	Alabama	100

Figure 6-1 presents the location of the proposed plant in Tishomingo County, Mississippi in relation to the Sipsey Wilderness Class I Area in northern Alabama.

The largest source of regulated air pollutants will occur from the plant's SAFs. As mentioned previously, the SAFs will be installed in phases and will be designed with a baghouse to minimize PM_{10}/$PM_{2.5}$ emissions prior to the associated exhaust gases exiting a 300 foot stack. Predicted concentrations of PM, NO_2 and SO_2 significantly drop with downwind distance from this plant. All other potential emission sources have been shown to result in their maximum concentrations at the property fence line or within one (1) kilometer of the proposed plant based on the configuration of the plant and being located east of the proposed plant site (not downwind of the plant based on the area's predominant wind flow south to north, and southwest to northeast), the proposed plant should have no effect on visibility impairment or resulting concentrations above the Class I increments.

The USDA Forest Service has requested that an AQRV Modeling Analysis for Sipsey Wilderness be included in the PSD permit application. The results of this analysis will be submitted as an addendum to this application upon completion.

Section 7: Suggested Permit Structure

Refer to the following tables for suggested permit language:

- Table 7-1 – Proposed Permit Conditions – Part II – Emission Point Descriptions;
- Table 7-2 – Proposed Permit Conditions – Part III – Emission Point Specific Limitations and Standards;
- Table 7-3 – Proposed Permit Conditions – Part IV – Emission Point Specific Compliance / Performance Requirements; and
- Table 7-4 – Proposed Permit Conditions – Part V – Emission Point Specific Recordkeeping / Reporting Requirements

Section 8: MDEQ Application Forms

Included in this Section are the relevant application forms that are required to accompany a request for a construction permit. The follow forms are provided in Appendix A:

- General Form;
- Additional Information Required for Applications, Existing Source Operating Permits, and for Approval to Construct;
- Emission Summary Section – Part I Stack Parameters;
- Emission Summary Section – Part II Regulated Air Pollutant Emission Rates;
- Emission Summary Section – Part III Regulated Hazardous Air Pollutant Emission Rates;
- Application Summary Section;
- Fuel Burning Equipment;
- Manufacturing Process Operations;
- Tank Summary; and
- L4 - Air Pollution Control Devices – Baghouse.

For purpose of streamlining the application, the forms make reference to tables within the application that provide the required information.

SILICON METAL PLANT AT BAKKI IN HÚSAVÍK
WITH PRODUCTION CAPACITY OF UP TO 66,000 TONS

ENVIRONMENTAL IMPACT ASSESSMENT

Environmental Assessment Statement
May 21st 2013

DRAFT VERSION

ATTN: The official document is in Icelandic.
English translation by EFLA Consulting Engineers

Front page photo: Mats Wibe Lund

Information sheet – Silicon metal plant at Bakki by Húsavík **Environmental Impact Statement**				
Authors: **Ólafur Árnason** **Alexandra Kjeld** **Friðrik Klingbeil Gunnarsson**	*Date.* **21.05.2013**	*Project:* **4507-001**	*Report number:* **N/A**	
Version	*Authors*	*Review*	*Date*	*Accepted*
1	*ÓÁ, FKG,PB, GG*	*ÓÁ*	*26.11.2012*	*ÓÁ/FKG*
2	*FKG*	*ÓÁ*	*30.11.2012*	*FKG*
3	*ÓÁ, FKG,PH, GG, AK*	*ÓÁ*	*28.12.2012*	*ÓÁ/FKG*
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5	*ÓÁ, FKG*	*ÓÁ*	*21.05.2013*	*ÓÁ*

SUMMARY

PCC SE plans to build a Silicon Metal plant at Bakki in H□sav□k, with the production capacity of 33,000 tpa and power requirement of approx. 52 MW. The plant will be designed with the further expansion capacity of up to 66,000 tpa and a 104 MW load. The plant will be allocated on approximately 22 ha area within the industrial area at Bakki in Nor□ur□ing municipality. The energy required for the production will be provided by geothermal plants in the geothermal region of Northeast Iceland. It is estimated that the plant will create 150 new jobs, not accounting for auxiliary positions created due to purchase of services and energy.

The project is subject to environmental assessment, in accordance with Annex 1 of the Environmental Assessment Act no. 106/2000. PCC SE has appointed EFLA Consulting Engineers to carry out the project‘s EIA.

Environmental Impact Assessment

This EIS addresses the environmental aspects that may be subject to considerable impacts due to the project’s reali□ation, both during construction and operation.

Emphasis is put on the following environmental aspects: Air Quality and Climate, Noise, Marine and coastal areas, Flora, Birds, Landscape and Visual impacts, Archaeological remains, Environmental Impacts during Construction, Social impacts, and Risk and security.

Air Quality and Climate

The effects of emissions on the Air Quality were modelled. The results showed an increase in the concentration of particle matter (PM10), sulphur dioxide (SO_2) and ammonia dioxide (NO_2), the estimated concentration is within the regulatory limit. The release of polycyclic organic pollutants (POP), polycyclic aromatic hydrocarbons (PAH) and ben□o (a) pyrene (BaP) is low and well within the reference values. The production process will release considerable amounts of carbon dioxide (CO_2), the increase is within the boundaries of the expected increase in CO_2 levels, through 2020, according to the government’s action plan on climate change. Emissions from PCC, when combined with emissions from other metal production companies within the assigned industrial area, can result in an increased risk of cumulative effects due to the release of chemicals in the atmosphere. Additional information of the location and release of chemicals by other companies is required for further analysis. The cumulative effects are considered to be local and dependant on specific weather conditions. With regards to the nature and scope of the effects on air quality and climate, the effects of the project are considered to be negligible.

Noise

Noise from the operation of a Silcon metal plant comes from both daily operation of the plant and harbour operations associated with the plant (i.e. unloading, loading and transportation to/from the plant). To estimate the noise effects, a model of the noise distribution was developed and the sound level calculated. Where residential areas are in close proximity to industrial area, the acoustics will meet the regulatory limits for noise due to both traffic and operations. The regulatory limits for noise will not be met without mitigation measures at the plant site boundaries due to close proximity of major noise contributors such as fans on dedusting, transformers and furnaces. The effects of the silicon metal plant in Bakki on noise are considered to be **negligible**, except in close proximity to the plant site and the harbour where tasks associated with it are performed.

Flora

The impact evaluation is based on field research, national registry and previous studies. In total, 108 species of high plants were found in the research area, mostly dry land plants since little wetland is in the research area. A few mosses, lichens and fungi species were identified, but no special focus was on the collection or analysis of these organisms. Heathland is prominent in the area but there are also spots where grasses are prevalent and eroded areas with spreading Alaska lupine. Wetland is mostly found in the northernmost part, in proximity to River Bakka□. No red list plant species were found during field research or in recent studies. The environmental impact of the project is mainly due to loss of vegetation removed during constructions, i.e. buildings, roads and car parks. Impacts on wetland vegetation near River Bakka□ are not expected due to changes in the riverbed and flow.

The proposed project is considered to have a ***considerable negative impact*** on vegetation and, since vegetation cover will be disrupted and the changes are irreversible. Possible mitigation measures include land reclamation using Icelandic plants, common in the area.

Birds

The impact on birdlife is based on field research, previous studies, international agreements and lists of species in threat of extinction and rare species. Based on observations and previous studies, 17 bird species are believed likely to breed in the research area, many of which are considered responsibility species in international cooperation. Breeding densities of grassland or heathland birds is assumed high in the investigation area. Bird species that are subject to impact due to the project are common, both nationally and within the region. Since the area of impact is relatively small, the construction is not believed to have an impact on the population si□e of species that breed on the industrial area or use the site in any other way. The proposed project is assumed to have a considerable negative impact on birdlife **within** the site.

Landscape and Visual Impacts

The effects of the Silicon Metal plant on the visual appearance of the area are foremost due to the proposed buildings at the plant site, with contributions from landscaping and land forming

The most apparent proposed structures are the furnace building and casting area with a height of 37,5 m, filter plant and raw material storage facilities at a height of 27 m and product crushing and storing at a height of 24m. All other structures have a considerable less height and therefore impact.

The effects on landscape are only thought to be local, but considerable within the plant site. No areas that are thought to have value due to their landscape features will be disrupted.

The effects on landscape are ***considerably negative*** permanent but reversible.

The Silicon Metal plant will generally not touch the skyline, since the lot is located in a slope and structures are therefore covered by land from most viewpoints. Though, it can be assumed that structures will be visible and touch the skyline seen from the national road and from the houses at H□□insh□f□i 1 and 2. A reduction of view is small, but evident from areas north of the plant.

The visual impact is ***considerably negative***, permanent but reversible from areas north of the plant and from above, that is from the national road, from G□nh□ll and other areas close to the plant. The impact is permanent but reversible. The plant is not visible from H□sav□k.

Archaeological Remains

The impact on archaeological remains was assessed on the basis of two archaeological studies, national registration and the National Heritage Act. A total of 21 remains were found in the studies, including an old path, mounds and a burial site. The mean preservation values of remains situated in the area south of River Bakka□ is 2.5, which is considered low, and none is believed in need of protection. The highest value (7) is assigned to remains at a location with a supposed fox trap. In this area, it is the archaeologist’s opinion that the effects of the project are highly acceptable, assuming full consideration during and after construction and taking appropriate mitigation measures if needed. Appropriate mitigation measures include recording the exact location, digging examination ditches and labelling remains. In the study performed in the area at and around River Bakka□, the remains are considered to be at risk due to the proposed project. No monumental value was assigned to those remains, but labelling is suggested to reduce the risk of disruption. If disruption cannot be avoided, authorization must be granted by the Archaeological Institute that also decides appropriate procedures and measures to be taken. Assuming all mitigation measures be taken where and when necessary, the impact is regarded as ***negligible***.

Environmental Impacts during construction

The assessment of environmental impacts during constructions focuses mainly on the temporary impacts on residents in Húsavík and nearby areas, i.e. due to transport of building materials, operation of heavy machinery and site preparation during construction. The plant will be constructed on an industrial property north of Húsavík, the closest houses situated approximately 1.2 km away from the south border of the plant's site. Given the distance from the village to the plant's site, it is unlikely that noise from on-site construction work will have an impact on residents of Húsavík. During hot and dry weather periods earth works might however cause dust pollution. This can be avoided by covering truckloads and spraying eroded areas during dry periods. Assuming the new road from the harbour to the plant's site is ready before beginning construction, and that appropriate mitigation measures are taken, the project will have a negligible impact on residents during the plant's construction, mainly due to increased traffic and noise. This impact is estimated to increase to considerable ***negative*** effect if the new road is not ready before plant construction, due to decreased traffic safety and increased noise.

These effects can be limited to an acceptable degree with several methods, such as selected transportation timing, definition of main transportation routes and marking of them.

Social Impacts

The assessment of the social impact of the project, both during construction and operation, is based on a previous EIA study and a study on the infrastructure in Northeast Iceland. The assessment focuses on impacts on population development, the labour market and on the municipalities in the region. The local region of Húsavík showed a population decline over a ten year period 2001-2010, especially among children and young adults. Services and administration within the municipalities can mostly accommodate a significant increase in population without having to expand, with the exception of pre-schools and health services. The construction of the Silicon Metal plant is believed to create around 200 man-years during the construction, and is considered to have a temporary positive impact on population development; labour force and the municipalities, due to jobs created and increased service demands from the municipalities, especially in health services. The operation of the plant will provide new permanent jobs; not including jobs created indirectly in relation to the project, and create revenues for the municipalities. The operation of the plant will therefore have a substantial ***positive*** impact on the population development, labour force and the municipalities.

Risk and Safety

The assessment of impacts due to risks to the health and safety of people and the safety of the environment is based on acts and regulations on buildings and structures; fire safety and other safety regulations; and documents on natural hazards, especially concerning earthquakes. The main risk issues are the risk of explosion where LPG is stored and risk of dust explosion in the material storages. The operation is planned in a seismic region, but other natural catastrophes are no significant threat to the operation. Risk management will be carried out to mitigate risk and to ensure they are dealt with appropriately. Performance based safety design and risk analysis will be carried out for the appropriate buildings, i.e. the storage of flammable gasses and raw materials and the risk factor accounted for in the design. All systems, i.e. fire detection and suppression systems, egress paths, fire fighting facilities etc. be according to regulations. The structures will be designed for appropriate seismic loads and fire. Risk analysis will be done on the effect of exhaust, waste, gas leakage or other factors and the effect on the health of people, property and the environment. Transformers, large fuel loads in storage facilities and the storage of LPG and oxygen call for the capacities of the fire brigade at Húsavík to be expanded. PCC will prepare a response plan on acute pollution of the sea in connection with an application for an operation permit. No raw materials transported through the port and used by PCC can cause acute pollution of the sea. Oils within transformers and fuel oil will be kept on site and proper safety cautions will be carried out for those. With appropriate measures, the emerging risks from the operation at Bakki can be minimised and the environmental impact due to hazardous events kept to a minimum. The effects are therefore considered to be ***negligible***.

Ocean and coastal areas (*Other alternatives – Sea water cooling*)

One option for cooling heat formed during the production is the use of seawater. This option can cause effects due to heat dispersion from cooling water and direct effects on the biota at the coast of Bakki. The cooling system itself will be closed and therefore no risk of pollution due to emission from the system. Calculations of the impact of the release of warm seawater at 5 meters depth show an impact area where the temperature rises by 1.2°C, which is below the maximum temperature of 2°C allowed to rivers and lakes outside of dilution zones. This calculation was carried out for both phases with similar results.

The construction of the seawater intake infrastructure will cause considerable disruption and alteration of the environment on a limited area at the Bakkakrókur shoreline, when parts of the shore will be excavated and covered with course wave breaking material. Although the construction itself is considered insignificant in comparison with the area it is affecting the long term impact is considered to be significant if sediments accumulate along the outlet and cause changes in the sea floor and benthic fauna. Furthermore, the accumulation could reduce diversity and quantity of costal biota. A possible mitigation measure is to situate the outlet pipe in shallow basins between the bedrock cuts to minimize the coastal surface impacted. It is therefore the conclusion that the impact of the option of sea water cooling can cause a ***considerable negative impact*** on a limited area on the Bakkakrókur coast.

Other aspects of the proposed Silicon Metal plant will not affect marine and coastal areas in any way.

Results

There will always be some environmental impact with a project of this magnitude. The direct effects of major factors, i.e. visual impact, are isolated to the plant site and areas in close proximity. The proposed PCC Silicon Metal plant will be located on an industrial site, just to the north of Húsavík. During the construction and operation of the plant, mitigation measures will be taken to minimize the environmental impact from the plant. The positive effect on the community is most apparent and would reach Norðurþing as well as neighbouring municipalities. Overall, the developer concludes that the environmental impact of the proposed PCC Silicon Metal plant is ***acceptable.***

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1 INTRODUCTION

1.1 General

PCC is an internationally operating group of companies under the leadership of PCC SE (formerly PCC AG) based in Duisburg, Germany. PCC today employs approximately 2,200 employees in 13 countries around the world. The company‘s sales generate from three main divisions: chemicals division, energy division and logistics division. The company plans to begin operations in Iceland, with the development of a Silicon Metal plant in Northeast Iceland. The production amounts to 33,000 tpa of Silicon Metal for a 52 MW power load, with a future expansion capacity of up to 66,000 tpa and a total of 104 MW power load. It is estimated that the plant will create 150 new jobs, not accounting for auxiliary positions created due to purchase of services and energy. The energy required for the production will be provided by geothermal plants located in the county of □ingeyjars□sla, Northeast Iceland

1.2 Environmental Impact Assessment

1.2.1 Reference to EIA requirements

The project is subject to environmental assessment, in accordance with Annex 1 of the Environmental Assessment Act no. 106/2000. The Annex lists projects that are always subject to environmental impact assessment: „Plants running operations of primary production and remelting of metals“.

This Environmental Impact Statement is based on a Scoping Plan approved by the National Planning Agency on February 2, 2012.

1.2.2 EIA management

The project developer PCC SE has appointed EFLA Consulting Engineers to carry out the environmental impact assessment for the project. Project management is summari□ed in Table 1 and the experts for assessments of individual environmental issues in Table 2.

Table 1: *EIA management for PCC SE’s Silicon Metal plant at Bakki in Húsavík.*

Company	Function	Employee
PCC SE	Project Development Management	Dr. Sabine K□nig
EFLA Consulting Engineers	EIA Management and IEIS editorial	□lafur □rnason

Table 2: *Expert Consultation for PCC SE’s Silicon Metal plant at Bakki in Húsavík.*

Company	Function	Employee
EFLA Consulting Engineers	Air pollution	Fri□rik K. Gunnarsson
EFLA Consulting Engineers	Noise	G□gja Gunnlaugsd□ttir
□lafur Einarsson, biologist	Birdlife and vegetation study	Dr. □lafur Einarsson
North East Iceland Nature Center	Marine Biology	□orkell Lindberg □□rarinsson
The Archaeological Office	Archaeological remains	Dr. Bjarni F. Einarsson Oddgeir Isaksen
EFLA Consulting Engineers	Risk and security	B□□var T□masson

1.2.3 Summary of the EIA process

The method used for the environmental impact assessment is in accordance with the Environmental Assessment Act no. 106/2000 and regulation no. 1123/2005. The assessment process is detailed in Figure 1.

Further information on the EIA process can be found on the NPA website, www.skipulag.is. This IEIA report will be submitted to the NPA for examination. According to the law the NPA has 4 weeks to deliver their opinion on the EIA for the project.

1.2.4 EIA and project schedule

The Initial Environmental Impact Statement is scheduled for submission to the National Planning Agency in May 2013. The agency's opinion is subsequently expected in July 2013.

The construction of the PCC Silicon Metal plant is set to begin in 2014 and finish in 2015 for the first project stage with 33,000 tpa production capacity.

1.2.5 Changes from the approved Scoping Plan

During the preparation of the project two alternatives have been up for consideration in regards to cooling. The first alternative is air cooling where cooling tower will be located within PCC's premises. A second alternative is cooling using sea water. For the second alternative it is proposed that a pumping station is located by the shoreline outside of PCC's lot. During the environmental impact assessment, additional information where gathered for potential effects on the shoreline's biology and birds by the shore. This information is provided in chapter 7.1.

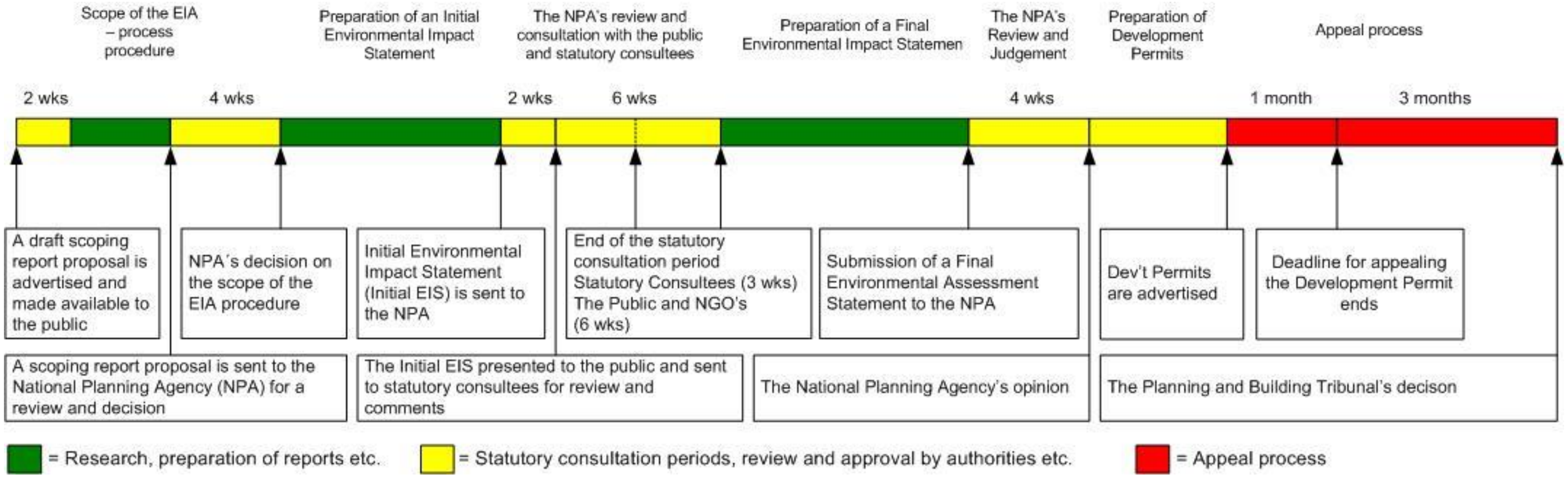

Figure 1: *Environmental Impact Assessment Process, in accordance with the Environmental Assessment Act no. 106/2000.*

2 PROJECT INFORMATION – ALTERNATIVE 1

2.1 Purpose and objectives

Industrial development at Bakki in the town of Húsavík is in accordance with the urban development plan of Norðurþing municipality. The industry's energy requirement will be provided by geothermal plants in the geothermal region of Northeast Iceland. The development of PCC SE's silicon metal plant is underway and located within the industrial area.

The plant will produce approximately 33,000 tpa of silicon metal during the first stage. The plant's total estimated power load is 52 MW for the operation of two electric arc furnaces (SAF, see chapter 2.3) and the relative auxiliary and peripheral equipment and facilities. The plant will be designed for future expansion, i.e. the addition of two SAFs of same dimensions, adding a total estimated plant load of 104 MW and production capacity of 66,000 tpa. Raw materials, i.e. quartzite (or quartz, see chapter 2.4.1), coals, wood, limestone and consumption material such as carbon electrodes, spare and wearing parts and refractory materials will be imported and shipped to the harbour at Húsavík, situated in proximity of the plant. The plant output, i.e. silicon metal and by-products of silicon-containing material in the form of slag and contaminated residues, will be exported to the worldwide market.

The plant will be built according to Best Available Technology (BAT), applying high heat utilization, closed cycle processes, best control of process performance, emissions without measurable discharges to surface water and ground water. No hazardous waste is associated with this silicon production process. The plants applied technology for the production and treatment facilities will be detailed later in this chapter.

2.2 Construction area and location of buildings and infrastructure

The plant will be built on a premises of approximately 22 ha (219,800 m^2), within an assigned 201 ha industrial area of Norðurþing municipality (see **Figure 12** and **Figure 13** in chapter 4). Plant dimensions, including building sizes and storage spaces, are listed in Table 3 and displayed in **Figure 3**. A preliminary model of the plant layout is displayed in **Figure 2**.

Total ground area is approximately 60,000 m^2 and total floor surface approximately 160,000 m^2. Total building volume is around 1 million m^3. Most of the buildings will be 5 – 12 m high, but highest points of elevation, the tip of the furnace building are approx. 37,5 m.

Figure 4 shows a photomontage of the actual PCC SE Silicon Metal plant as seen from the north.

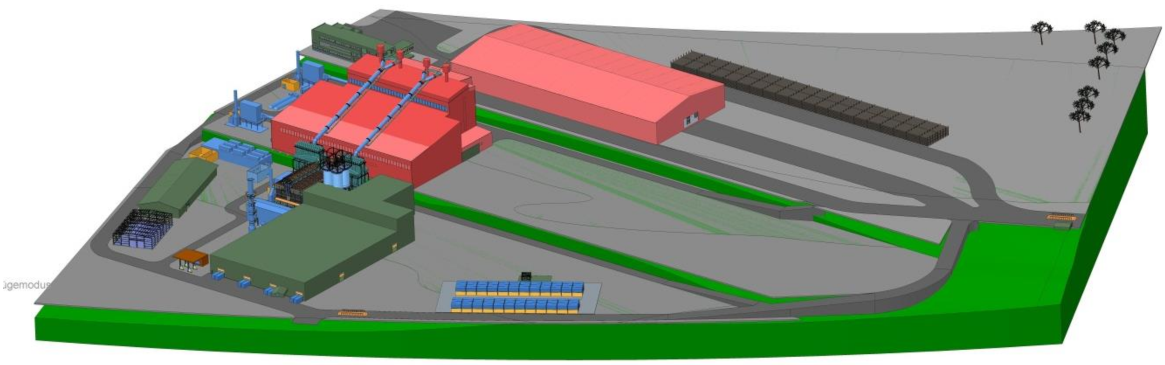

Figure 2: *Preliminary model of the PCC SE Silicon Metal plant layout at Bakki in Húsavík.*

Figure 3: *Overview of PCC SE Silicon Metal plant layout, showing location of plant buildings on the plant’s assigned premises at Bakki in Húsavík.*

Table 3: *Building and infrastructure dimensions for the PCC SE Silicon Metal plant layout at Bakki in Húsavík.*

Facilities	Ground area (m^2) for 33,000 tpa	Ground area (m^2) for 66,000 tpa	Height (m)
Furnace building, casting area	8.160	16.320	14 - 37,5
Bag house filter plants	4.210	8.420	27
Product storage, product crusher	8,450	8,450	23,6
Raw material storage facilities/logging area	10.880	21.760	27
Workshops and warehouse	1.625	1.625	8
Log area	3.600	3.600	-
Administration, canteen, social facilities, and central laboratory	2.133		7
Garage	450	450	5
LPG Storage	16,5	16,5	3
Fuel Station	450	450	roofed
Water treatment, etc.	2 x 800	2 x 800	□5
Cooling water plant	585	585	7
Substations	4x 150	8x150	6
Parking lot	800	800	-
Container area	4.365	4.365	-
Switchyard			

Figure 4: *Photomontage showing the PCC SE silicon smelter at Bakki by Húsavík as seen from the north. (Photo: Mats Wibe Lund).*

2.3 Production process

The plant will be designed and built to produce Silicon Metal (≥ 98.5□) from imported raw materials; quart□ite and the carbon materials; low-ash reactive coal, low ash coal char, char coal, woodchips and small amounts of limestone.

The raw materials will be transported on ship to H□sav□k harbour and from there by trucks to the raw material storage on site using an industrial road and tunnel the Icelandic Road Authorities (Vegager□in) plans to build to serve the industrial area. In this way traffic by-passes the densely populated area in H□sav□k. During normal operation of the logistic chain, no storage of bulk materials is foreseen at the harbour area.

The raw material storage will be located south-east of the furnace building on an area of approximately 10,900 m^2. The materials will be stored outdoors in compartments under roof, except for quart□ which will not be covered but with a spray-system installation to prevent dust formation. Logs for the production of wood chips will be stored on a 3,600 m^2 outside area located behind the raw material storage, but the preparation and storage of wood chips will be under a roof. Each compartment will have a concrete floor and reinforced concrete walls to provide sufficient fire protection for different materials. The roof is made of steel girders and steel cladding. The maximal height of bulk coals and bulk woodchips will be □4.5 m to prevent spontaneous combustion. The raw material will be transported from the raw material storage by underground conveyors to the day bins located inside the furnace building.

For the first phase the production will take place in two electrical submerged arc furnaces, each operated at a nominal load of 24 MW, producing ca. 32,000 tpa of finished silicon metal, i.e. producing roughly 33,600 tpa before assumed 5□ losses due to tapping/crushing (2□), oxygen blowing (1□) and ladle losses (2□) Operating times of >99□ of the available time can be achieved in average, but at the beginning the operating time should be at least above 95□. A load factor of 100□ is expected during operation. The production will use prebaked amorphous carbon electrodes.

In the second phase the production capacity will be increased by adding two further furnaces south of the furnace building. After the second phase the total production capacity of the plant will be 66,000 tpa with a total nominal load of 96 MW. The second phase also involves an increase in other facilities such as the dedusting plants; raw material and product storages; and the log area. An enlargement of the administration and canteen building; the cooling water plant; and the fuel station is not planned in the second phase.

In addition to the electrical load required for the smelter operation, the plant requires approximately 4 MW to operate the exhaust treatment. In total the electrical load required for the plant is estimated to be 52 MW in the first phase. With the further expansion, i.e. the addition of two SAFs of same dimensions, the plant will have an estimated total electrical load of 104 MW.

The quantity and mixing of the raw materials or the preparation of the feed mixes (batches) is controlled be the batching system and the transfer system between batching system and furnace silos. Eight to ten complete batches are prepared every hour and conveyed into the relative furnace silos. The feed mix is loaded into the furnace through charging tubes. The furnace burden is stoked and piled up towards the electrodes by a stoking machine to promote a continuous and uniform flow of the raw materials through the furnace shaft and into the reaction □ones.

The major part of the quart□is reduced with reactive reductant coal to SiC which represents the main reducer for the remaining unreacted quart□ in the reaction □one underneath the electrode tips.

The overall reactions of the Silicon Metal process follow the equations:

SiO_2 □2C □ Si □2□CO□
SiO_2 □3C □ SiC □2□CO□ (furnace shaft)

This reaction transforms about 66□ of the Silica and 100□ of the Carbon available in the feed mix into Silicon Carbide.

The final reaction takes place in the reaction □one above the furnace hearth at temperatures well above 1.835ºC. The arc between the electrode tips and the hearth maintain temperatures up to >2.000ºC which are needed for the final reaction between Silicon Carbide and the Silicon Oxides (SiO_2 and SiO):

$2SiO_2$ □3SiC □ 4Si □□SiO□□3□CO□
SiO □SiC □ 2Si □□CO□

These combined reactions transform the available Silicon in form of SiO_2, SiO and SiC at highest temperatures in the reaction crucible to condensed Silicon that accumulates in the metal bath and is tapped as Silicon Metal.

The overall reaction is never complete but Silicon recoveries can be as high as 95□ with well controlled Process performance. The correct dimensioning and set-up of the furnaces and auxiliary or peripheral equipment and the skilled operator personnel play a major role in the overall plant performance.

Figures 5 and 6 show a typical submerged arc furnace of similar type as will be used in the PCC plant.

Figure 5: *Submerged arc furnace (Source: SMS Siemag).*

Yellow: Raw materials,
Green: Electrical Energy,
Red: Silicon metal,
Blue: Off gas

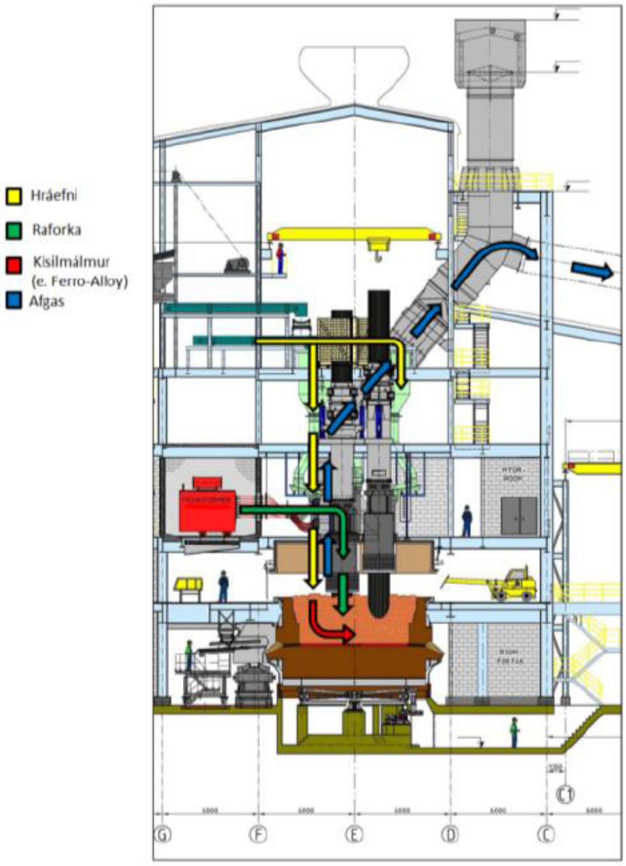

Figure 6: *Submerged Arc Furnace for the production of silicon metal (Source: SMS Siemag).*

The smelting and production of the silicon metal takes place in Submerged Electric Arc furnaces, see Figure 6. The furnace is divided into two sections, an upper part above the smoke hood and a lower part where the actual reaction and the production of the silicon metal takes place.

The raw materials (yellow) are fed from the day-bins through feeding channels in the smoke hood and into the furnace. The pre-baked carbon electrodes are placed in the top of the oven and reach down through the smoke hood into the lower part of the furnace, where the reaction takes place. In the smoke hood, the off gasses (blue) are collected and transported to the air treatment units/bag house filters and also heat is conveyed out of the furnace building.

Regularly, the metal is tapped from the furnace into ladles, re-fined and casted into moulds in the casting bay. After cooling down, the ingots are pre-crushed and stored in the intermediate storage within the furnace building. From the intermediate storage the product is transported to the product crusher bay. After crushing, the product is screened and packed and stored before transport.

Part of the process involves intermediate compounds such as silicon carbide ($SiC_{(s)}$) and silicon monoxide ($SiO_{(g)}$) gas, which can escape the process and significantly reduce the yield of the silicon metal. In the furnace shaft a major part of the Silicon monoxide can be recovered and recycled into the furnace hearth where it participates in the final process. In the production solid waste is produced only in small amounts, because most of the content of the raw materials is transformed to Silicon Metal; a certain part moves into the slag and a considerable part leaves the furnace as silicon monoxide (SiO), oxidises and precipitates as Micro Silica captured in the bag house filter. All exhaust from the furnace and the ladle (refining process) is captured.

The production process produces slag only in little amounts and most impurities pass over from the raw materials and consumables into the product or by-product (Micro Silica). A refining step will be implemented to reduce the amount of certain impurities in the tapped metal. The refining is done by injecting Oxygen-enriched air through a porous plug in the bottom of the ladle. Any exhaust from this process will be treated in the same way as any other exhaust from the plant. No water is used in the production or cooling process, therefore no production water is discharged into sewage

Figure 7 provides an overview of processes in the production of silicon metal.

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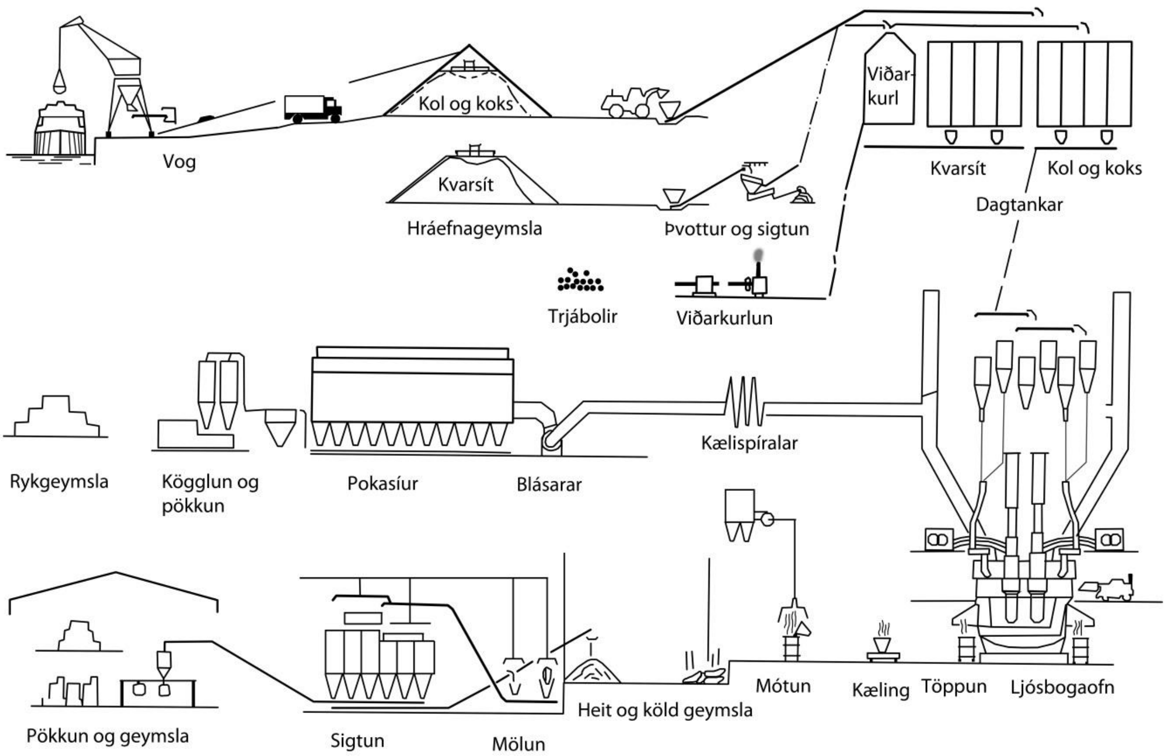

Figure 7: *Simplified diagram for the production of silicon metal.*

2.4 Process materials

The main raw materials used for the production of Silicon Metal are quartzite, low-ash high volatile reactive coals (mainly from Columbia, Venezuela, and USA), char coal, wood chips and small amounts of limestone for metallurgical corrections. Other main consumption materials are pre-baked Carbon Electrodes which might be substituted with the composite electrode system as used today for all furnaces with electrode diameter of ≥45", graphite lances, tapping tools, plugging materials, oxygen, compressed air, porous plugs, fresh water and chemicals for the treatment of the cooling water, graphite crucible for the sampling of liquid metal and disposable thermo-couples for measuring metal temperature. Altered from the initial plan as submitted in the scoping document, ladles will be pre-heated using electricity, which reduces the amount of LPG used in the factory down to only 1,040 tons per year for the 1st phase. A few bottles of nitrogen will also be used every once in a while to refill the hydraulic accumulators.

The cooling circuits that cool the furnaces and transformers will be filled with municipal water and lead through heat exchangers for cooling. The heat exchangers can be cooled by using either air cooling or with seawater. In this IEIS both systems for cooling are presented, see chapters 2.5 and 3.1.

Table 4 displays the main amounts of materials and compounds needed for the annual production of 33,000 – 66,000 tonnes of silicon metal.

Table 4: *Materials used in the production process and annual quantities needed for the annual production of 33,000 – 66,000 tonnes of silicon metal.*

Material	Chemical compound	Quantity for 33,000 – 66,000 tpa production volume	Role
Quartzite	SiO_2	81,000 – 162,000 tpa	Raw material
Coal (high bituminous low ash coal)	C	42,000 – 84,000 tpa	Reductant carbon
Wood chips	C	45,000 – 90,000 tpa	
Coke (low ash coal char)	C	15,000 – 30,000 tpa	“
Char coal	C	8,000 – 16,000 tpa	“
Electrodes	C	4,000 – 8,000 tpa	“
Cooling water (sea water)		1,200 – 2,400 m^3/h	For cooling of heat exchangers
LPG		1,040 tpa	Equipment heating
Oxygen		410 tons	Refining and use at the tap hole
Graphite lances and stinger rods		30-60 tpa	“
Refractory materials (ladles)		500-1000 tons	“
Tap hole plugging materials		70-140 tons	“
Plugs for metal refining		0,7-1,4 tons	“
Disposable thermo elements		0,45-0,9 tons	“

2.4.1 Quartzite

Quartzite will mainly be imported from mines in continental Europe, including a PCC SE mine in Poland, but the possibility is also open for import from other continents. The quantities of quartzite for the production of 33,000 - 66,000 tpa of silicon metal are estimated to be approx. 81,000 – 162,000 tonnes, i.e. the equivalent of 6,750 – 13,500 tonnes per month, taking into account the possible exclusion of shipping during three winter months.

Quartz might also be used for the production instead of quartzite. Quartz and quartzite are closely related substances, i.e. quartzite is actually weathered and deposited quartz that has solidified into sandstone and then undergone a metamorphic event to form quartzite. Quartz and quartzite are mainly composed of Silicon dioxide (SiO_2) or >99%, and the difference between the two compounds are found in trace elements of <1%.

Information on the composition of Quartzite can be found in Annex 1.

2.4.2 Carbon materials

The electro-thermal process of silicon metal takes care of the necessary heat input into the reaction zones below the three electrodes. The reduction of oxides, namely silicon oxides, performs under very high temperatures, reacting to metal (Si), metal oxides (SiO) and metal carbides (SiC). This reaction requires approximately 400 kg C_{fix} per tonne of silica, imported in the form of coals, char coal, coke, wood and Carbon Electrodes made from coke or imported pre-made.
The amount of carbon (C_{fix}) provided by the Carbon material can vary, although stoichiometric amounts are required for the process. The content of effective carbon (C_{fix}), is assumed to be. 55% for the coals and max 20% for the wood chips.

Information on the composition of carbon materials can be seen in Annex 1.

2.4.3 Consumables

Consumables are materials that are used in the production but do not become part of the product. The main consumables are ladle lining, graphite lances for electrical stinger and for opening the tap hole, steel pipes for oxygen lancing of the tap hole, plugging materials to close the tap hole and disposable thermo couples for measurement of the metal temperatures during and after tapping in the ladle.

2.5 Cooling

The cooling system for furnaces, hoods and casting machines consists of closed cooling circuits, which are cooled down using heat exchangers. The water in the cooling circuits will be treated in order to reduce corrosion and eliminate eventual bacteria growth. The circuits are filled and once in operation only small amounts of water are needed for back-up or replacement to compensate for water losses due to leaks and evaporation. A minor discharge of the primary cooling water of around 0.3 m^3/day is expected which will be discharged with other water. The whole system is equipped with a flow monitoring and alarm system to prevent liquid water to enter the furnace crucible.

In this EIS the option of two cooling systems are presented; a cooling water plant (air-cooling) and cooling by means of seawater. Both solutions are based on closed cooling circuits.

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Figure 8: *Cooling towers with cooling fans on top [Source SMS Siemag].*

The cooling water plant is seen as a 45 x 13 m large building with an approximate height of 7 meters, located north of the furnace building. This height includes the cooling fans placed on top of the building. Typical cooling towers are shown in **Figure 8**.

Further information on the release of sea water used for cooling and the environmental impact can be found in chapter 3.1 and chapter 7.1.

2.6 Process residues: by-products and solid waste

The production of silicon metal generates a variety of residues that can mostly be recycled or reused within the production or sold as by-products for use in other industrial processes. Those materials are generated at different stages in the production, such as in the production process, during off gas treatment, waste water treatment and general cleaning of the site. The most significant residues from the production process are filter dusts, sludge from water treatment, slag from the reduction process and refining, used furnace linings and diverse packaging materials such as drums and big bags. Ladle linings are replaced every 10 to 15 years.

Design and operation of the production line aims for maximum use of raw materials and minimi□ation of residues that cannot be applied in other processes.

PCC does not plan to landfill any inert residues on site. All residues defined as waste that has to be disposed of will be handed over to qualified waste service providers.

Sorpsamlag □ingeyinga is a licensed service provider and can receive all different types of waste, including inert waste from the area.

2.6.1 By-products

Most of the solid by-products generated during the production of silicon metal can either be reused within the production or recycled. The waste mainly consists of metallurgical slag generated during the production process and dust collected in the dedusting plant.

The production of silicon metal is a nearly slag free process, with the amount of slag amounting to around 25 - 40 kg slag per ton of silicon metal or at an estimated 900 – 1.400 tpa for 33.000 tpa and 1.700 – 2.800 tpa for 66.000 tpa.

Silicon dioxide dust or Micro Silica is generated in furnaces and silica dust (fine material) during the crushing of products, it is then collected from the plant exhaust treatment facilities and used in different industries. The expected amount is around 12,000 tons for 33,000 tpa and 24,000 tons for 66,000 tpa. The dust, or Micro Silica, can be used as major component in special concrete mixes, as additive in the refractory industries and a great number of applications in the production of, insulating materials, mortar, plaster, etc.

The largest part of waste coming from maintenance on equipment will be recycled.

2.6.2 Solid waste

The operation of the plant will operate on the principle of minimi□ing waste generation and maximi□ing recovery and the recycling of waste. All waste generated on site will be sorted as much as possible and, if not used within the operation of the plant, be handed over to qualified waste service companies. Other waste generated during production mainly consists of furnace and brick linings that will be disposed of as inert solid waste in accordance with law and regulations.

Another type of waste is packaging materials and waste generated in maintenance of the plant as well as household waste from offices and canteen. Annual waste quantities and applied treatment is listed in Table 5 below.

Table 5: *Waste types, annual quantities and applied treatment, produced in the annual production of 33,000-66,000 tonnes of silicon metal.*

Waste type	Annual amount [t/year] for 33,000 tpa and 66,000 tpa	Treatment
Filter bags	0,06-0,12	Recycling in Ferro Silicon or Silicon Metal process
Ladle lining	340-680	Inert landfill
Metals	180-360	Metal recycling
Timber	130-260	Timber recycling (not on site)
General waste	70-140	Landfill
Big bags	9-18	Recycling
Cardboard	3-6	Recycling
Earth materials/concrete	2,5-5	Inert landfill
Cyclone dust (*icel. Forskiljuryk*)	840 – 1.680	Landfill
Waste from sieving of raw materials	2.5 – 5	Landfill
Organic household waste	4-8	Recycling
Ha□ardous waste	1,5-3	Proper treatment through Ha□ardous Waste Depot

2.7 Emissions to air

Airborne emissions generated in the production can be divided into two categories; dust emissions and gaseous emissions (fumes). Dust emissions can arise by handling and storing of raw material, refining, crushing and packaging of products and by-products as well as by the smelting process in the furnace. Gaseous emissions however arise almost entirely in the furnace.

To minimi□e dust emissions in the raw material storage, material will either be transported by overhead-cranes from the storage compartments to the conveyor belt feeding the day-tanks or with front end loaders, in which case, spray-systems will be installed so water can be sprayed on the material to prevent dust from arising.

Under the gas hood, silicon monoxide (SiO) oxides into amorphous SiO_2, this is then captured by the filter bags as extremely fine dust (< 1 micron). The clean gas that leaves the filter has very low dust content (< 5 mg/Nm^3) and the remaining dust leaving the filters cannot be seen.

Gaseous emissions arise mainly from the furnaces. The main components are sulphur dioxide (SO_2), nitrous oxides (NO_x) and carbon dioxide (CO_2). Carbon monoxide (CO) emissions are considered negligible. The emissions contain only very little amounts of organic pollutants, such as polycyclic aromatic hydrocarbons (PAH) and polycyclic organic pollutants (POP). High surface temperature prevents the creation of dioxins and furans.

Metals are present as trace elements in the raw materials and are as such carried into the process. Metals that have high vapour pressure will escape the process as gases but most of them will be collected through the fume collection system and removed from the off-gas.

The release of CO_2 from the operation has been calculated to be 181,500 tons annually for the 1st phase and 363,000 tons annually after construction of the 2nd phase. PCC will obtain the necessary allowances under the EU European Trading System (ETS), by application to the Environmental Agency of Iceland.

Currently, two other projects are being considered in the Bakki industrial area but both of them are only in preliminary stages. Both use similar raw materials and the same type of pollutants are emitted, i.e. sulphur dioxide (SO_2), ammonia dioxide (NO_2), carbon monoxide (CO), particle matter (PM10), and Polycyclic aromatic hydrocarbons (PAH).

The proximity of industries in the area can lead to an accumulation of pollutants inside the industrial area. However, detailed data allowing for the modelling and evaluation of air quality from the other two projects are at this point not available since location and specifications on technology have not been decided. Therefore the cumulative effect of air pollution in the area cannot be assessed fully at this stage, but will be done in the EIA for the respective projects. In chapter **Error! Reference source not found.** the potential cumulative effects are however addressed to the extent possible considering the data available from other possible projects within the area.

2.8 Noise

Main sources of noise and vibration at the PCC SE plant in Bakki are related to the materials and product handling systems and fans of the dedusting systems and the furnace bottom cooling system. Another source of noise is from chipping of wood logs at the storage area. Noise generated inside buildings will only escape to a little extent and will not cause significant increase in the noise level on site.

Some noise will occur from the unloading and loading at the harbour area and from transport to and from the site.

Further information on noise due to production can be found in chapter **Error! Reference source not found.**

2.9 Energy requirement

The total energy requirement for the first stage is estimated to be 52 MW or 455 GWh per year, for the production volume of 33,000 tpa. The plant will be designed for a future expansion with a total energy requirement of 104 MW or 915 GWh per year, for 66,000 tpa production volume.

Negotiation is on-going between PCC and Landsvirkjun on electric power provision for the plant.

2.10 Transport and storage of materials

The main transport is due to the import of raw materials for the production; quart□ite, coal, coke and wood and export of products and by-products, through the harbour in H□sav□k. The amount of wood logs is based on the assumption that all wood is imported and shipped to the harbour in H□sav□k. If feasible amounts of wood meeting the requirements of the production can be found, domestic sources will be favoured.

The transport categories and amounts for 33,000 and 66,000 tons production volume can be found in **Table 6Table 4 - Table 8**.

Quart□ite and low ash coals will mostly be transported as bulk, other materials in containers. Wood will be transported as logs in stacks or as wood chips. The transhipment volume is around 20,000 tons per month or 250,000 tons yearly for 33,000 tpa production volume and 40,000 and 500,000 tons for 66,000 tpa.

The material storages of the plant will have enough quantities of materials and other consumables in stock in case of a temporary transport stop because of bad weather or failure in equipment. The expansion of the supply storage facilities will not be done alongside the expansion of the plant from 33.000 tpa to 66.000 tpa productions. The increase in materials will be met with more frequent imports.

Table 6: *Transport and storage of materials.*

Material	Form of transport	Amount/frequency for 33,000 tons yearly production	Amount/frequency for 66,000 tons yearly production
Quart□ite	Bulk	□6,800 tons/month	□13,600 tons/month
High bituminous low ash coals	Bulk	□3,500 tons/month	□7,000 tons/month
Char coal	40 feet containers	□700 tons/month	□1,400 tons/month
Low ash coke	20 feet containers	□1.250 tons/month	□2,500 tons/month
Wood logs	Stacks in containerships	□3,750 tons/month	□7,500 tons/month
Electrodes	Containers	□350 tons/month	□700 tons/month
Other consumables	20 feet containers	□50 tons/month	□100 tons/month

Table 7: *Transport of material from the production.*

Material	Form of transport	Amount/frequency (for 33,000 and 66,000 tpa)
Silicon metal	20 feet containers	□2.750 – 5.500 tons/month
Micro Silica dust	20 feet containers	□1.200 – 2.400 tons/month
Slag	20 feet containers	□350 – 700 tons/month

Table 8: *Maximum amount of material in stock.*

Materials	Maximum amount [tons] on stock for 33,000 and 66,000 tpa
Quart□ite	47,200
High bituminous low ash coals	16,300
Coal	7,500
Low ash coke	600
Wood	21,000
LPG	350

2.11 Construction information

During the construction period the work camp will be located inside the proposed construction area. Offices, dining area and toilets will be located within the camp. Sleeping/living facilities for temporary workers will be required; the bulk of the workers will take advantage of the facilities available in H□sav□k. The exact location of the camp has not been decided, but will most likely be situated at the location of the proposed office building.

All surface material will be used for landscaping in the area, except for rocks and gravel which will be used to the fullest for areas/lots, foundations and roads, for both PCC built roads and the municipality projects.

The channel of Bakka□will not be altered by the construction and strived at not to disrupt the wetlands on the NW part of the proposed site.

2.12 Related projects

The project is dependent on electric power and its transmission to the plant. Electric power will be provided by geothermal plants in the geothermal region of Northeast Iceland.

An EIA has already been carried out for transmission lines (220 kV) from Krafla and □eistareykir to Bakki at H□sav□k, to Sk□tusta□ahreppur, A□ald□lahreppur, □ingeyjarsveit and Nor□ur□ing, and the NPA has issued an opinion of the EIA, dated November 24th, 2010. An EIA has also been carried out for geothermal power plants □eistareykjavirkjun (up to 200 MW) and Kr□fluvirkjun II (up to 150 MW), with a Reasoned Opinion of the NPA also dated November 24th, 2010.

The transport of materials from the harbour will be done with a trailer train through a new industrial road and tunnel through cape H□sav□kurh□f□i which will be built and operated by the Icelandic road authorities and the Nor□ur□ing municipality. The use of this road will prevent transport via the populated area in H□sav□k. No storage of materials is foreseen at the harbour, except possible temporarily storage of container units in case of transport delay.

A proposed layout of the industrial road from the harbour towards the industrial site is shown in **Error! Reference source not found.**.The trailer trains consist of special low speed vehicles (max 30-35 km/h) designed for transport on roads that are meant for industrial transport.

In the event of a temporarily blockage on the industrial road or the tunnel, for example due to weather conditions, maintenance, or accidents, materials will be transported on the public roads using regular transport vehicles available.

Figure 9: *Proposal (Bökugarðsleið) of the industrial road from the Húsavík harbour to the industrial area at Bakki. (Map: National Road Authorities).*

2.13 Review and comments on project information and PCC's answers

2.13.1 Review and comments on transport through the harbour

The Health Inspectorate of NE Iceland (HNE) comments on the storage of raw materials in the harbour area comments: "*It's stated in Chapter 2:3 Production Process that during* *regular operation no storage of goods (materials) is foreseen at the harbour area. Chapter 2.12 on related projects states that no storage is for seen in the harbour area, with the exception of temporary storage of bulk materials if there is a delay in transport. Chapter 6.2.4.3 Transport between harbour and industrial area this is described more preponderantly: "Much storage at the harbour area is not foreseen, because it is planned that materials will be transported immediately to and from the harbour area". It cannot be avoided to conclude that some storage will be at the harbour area. The HNE believes it should be clearly explained which materials will be stored there and how, i.e. with respect to the risk of fines from coals and Quartzite and other substances blowing away. It should be checked if there is a reason to build over all materials where there is a risk of materials blowing away."*

Answer PCC: As mentioned in the EIS it is expected that all raw materials will be transported to the raw material storage on the company site after unloading and therefore no materials will be stored at the harbour area, expect in exceptional circumstances for a short time when there is a delay in the regular logistics to the site. If it becomes clear that there will be delays in transport, further unloading will be stopped and the suspension of materials prevented using irrigation or coverings. That is therefore PCC's estimation that there is no reason to build over materials that might be stored temporarily at the harbour.

2.13.2 Review and comments on water use and cooling

The Icelandic Met Office comments: "*The IEIS is lacking information on water and water stress, but those issues need to be well addressed. Thus should, for example, a better explanation be given on the water use, compared with available water in the area and if it is awaited that the water source will withstand. The impact of cooling, amount of water used, which chemicals will be used to prevent corrosion and to prevent bacteria growth needs to be addressed. It is also important to mention where leakages from the cooling system will most likely occur. It is necessary to study the impact if all water is lost from the system in a relatively short time.*

Answer PCC: No water is used in the production process itself or for the cooling of metal. Drinking water will be used to tap the cooling water circulation of furnaces and transformers (0.3 m^3/day), for cleaning of equipment. The maximum water demand of the plant will be 180,000 m^3/year for 66,000 tons production capacity. In the statement with the local plan for the industrial area at Bakki (Mannvit, February 2013) is stated that to provide the total industrial area with its demand for drinking water, cold water will be fed to the site from sources in Rivers Bakka, Reyar and Kaldakvsl. It is planned to activate springs at the source of River Bakk, in around 2.5 km distance from the planning area. To meet requirements on available amount of water for fire extinguishing, it is proposed to build a reservoir with a dam about 150 m east of Highway 85, in the gorge of River Bakka resulting in a water surface level in around 60-65 m over sea level.

Information on which chemicals will be used to prevent corrosion are not available, but there will likely be an addition of molybdate or phosphate, but the decision on which chemical will be used will be taken in the final design stage and tendering of the cooling systems for the plant. The concentration of the additive will likely be around 1g/L. Information on which chemicals will be used to prevent bacteria growth is not yet available.

For the 66,000 ton production capacity, there will be around 350 m^3 of cooling water in the cooling circuits for furnaces and 80 m^3 in the cooling systems for transformers. The main points of water leakage from the circuits are circuit packs in the heat exchangers, mechanical seals of pumps and security valves. An alarm will be installed for the case of leakage from the cooling system. Containers will be installed for smaller leaks from the cooling system. Corrosion of pipes is not expected, as the material of piping will be chosen in respect of the cooling agent. In the event of a large leak from the cooling system the water will go into drains and to the sea, and the impact on soil and groundwater therefore considered negligible.

2.13.3 Review and comments on by products and solid waste

2.13.3.1 Review of the Icelandic Met Office

The Icelandic Met Office comments: “There is need for better explanation of possible ha□ardous chemicals in waste that could pollute water or soil in the area. Information is missing on chemicals that might derive from solid waste that gathers/accumulates or is handed over for disposal in the municipality. It must be stated if it is likely that the waste can contain heavy metals or something else and can be infiltrated into the ground and affect the water quality. It can be considered abnormal to base the EIA on certain given assumptions, which are not yet available and it is of importance to get a statement on those tasks or conditions from the respective parties. For example, it is stated that waste collected from the production will to a large extent be disposed of by authori□ed service providers. Up to 2,513 thousand tons of waste will be generated in the production and it is necessary to further explain its disposal within the area and if authori□ed service providers are capable to receive such amounts and the specific waste generated in such production.

Answer PCC: It is not clear where the amount 2,513 (thousand) tons is obtained. As stated in the EIA it is not expected that any waste will be landfilled within the site. A temporary storage of by-products or waste is possible, but the storage will be on a lot with a closed surface (asphalt or concrete) so no chemicals can be carried into the soil. According to information from PCC it is expected that a large amount of by-products can be marketed, so that the amount of materials that needs to be disposed of is significantly lower than shown in the EIS. It can be assumed that ladle linings and dust (other than Micro Silica) can be used rather than disposed. Thus, the estimated amount for disposal from 33,000 and 66,000 tons production capacity is around 70-140 tons and around 5-10 tons that can be disposed of as inert waste.

Some of the helping agents used for ladle- and furnace linings are of such nature that if they are exposed as single compounds without mixing they can cause a negative impact to the environment. To prevent this, the handling and use of chemicals for ladle- and furnace linings will be in designated areas with closed surfaces. In the lining itself the chemicals in question are bound together with other chemicals and therefore don’t cause any risk. In the Annex SDS for every chemicals used in linings can be found. It is expected that linings will pass the leaching test and can be disposed of as inert waste.

2.13.3.2 Review of the Health Inspectorate of NE Iceland

The Health Inspectorate of NE Iceland (HNE) comments on by-products and solid waste: “*It is stated that PCC plans not to landfill any inert waste within its site and all products that will be declared as waste will be handed over to an authorized service provider for treatment. That party will be Sorpsamlag Þingeyinga [comment EFLA: Municipal Waste service provider], which is an authorized service provider and accepts all sorts of waste in the area, incl. inert waste. According to this, Sorpsamlag Þingeyinga will have to receive waste of annually around 1250 tons per year for 33,000 tons production capacity and 2500 tons if the plant will be enlarged up to 66,000 tons production capacity. HNE has several remarks. Firstly, there is no place within Norðurþing municipality that has a valid operational permit to landfill waste. Secondly, it shall be pointed out that Article 11 of regulation 737/2003 says:” The generation of waste shall be reduced as possible. Reuse and recycling shall be aimed at as much as possible. Best available technique shall be applied for treatment of waste.” The HNE points out that in the operation permit of Elkem Iceland, that produces silicon- and ferro-silicon, the company may dispose diverse waste groups in flood pit, with leaching of* *chemicals into the sea as the concentration of the pollutants are not higher than reference values in regulations. The report from the National Planning Agency regarding the Agency's decision if the production of polysilicon at the Elkem Iceland plant at Grundartangi is a subject of full scale EIA states: " the permission of Elkem Iceland ehf. in the operation permit to put waste materials in the port filling at Grundartangi are only used to a limited extent, because methods of recycling have been found for a greater deal of materials then it is allowed to dispose of." With reference to this, the HNE believes that PCC should investigate available recycling possibilities in the purpose of minimizing waste for landfill as much as possible*

Answer PCC: The operation of the silicon metal plant will seek to maximi□e the amount of sellable products from the production and reduce the amount of waste deriving from the production. According to new information the amount of sellable by-products is higher than stated in the IEIS, for example cyclone dust (840-1,680 t/year) and used linings (350 – 700 t/year) are sellable materials and not waste. The main sources of waste will therefore be packaging waste, i.e. plastic wrappers and timber, that are suitable for recycling as well as household waste, that can be directed in the same path together with other waste materials in the region. Waste for recycling is therefore estimated at 326 t/year for phase 1 and 652 t/year for both phase 1 and 2. Waste for landfill is estimated at 70 t/year for phase 1 and 140 t/year for both phase 1 and 2. Inert waste that is generated and not recyclable can be landfilled at the inert landfill at Laugarbakki after passing a leaching test. The amount of inert waste that can be disposed in this manner is estimated at 5 t/year for phase 1 and 10 t/year for both phase 1 and 2.

2.13.3.3 Comments from residents and landowners of Héðinshöfði

Residents and land owners of H□□insh□f□i comment: *"If waste from the production will be landfilled close to the town of Kópasker, an assessment of the increased traffic on the highway, as well as emissions and other discomforts this traffic will cause is demanded".*

Answer PCC: As stated in the IEIS all waste from the plant will be handed over to Sorpsamlag □ingeyinga (municipal waste service provider). At this point in time it cannot be answered what are the future solutions of S□ and where they will be located. It is not assumed that there will be a significant increase in traffic because of this transport nor that waste will be transported to K□pasker.

2.13.4 Review and comments on the construction

The Health Inspectorate of NE Iceland (HNE) comments: *„… during construction it is assumed that work camps will be within the construction site. There will be offices, canteen and toilet facilities. Furthermore it is foreseen to provide housing facilities for staff working temporarily on site, but that the main part of the staff will use sleeping facilities in Húsavík. The location of the work camp has not yet been decided, but the facilities will probably be located at the prospected location of the future office building. The HNE considerers it to be necessary to provide information on the location of those structures. Laws and regulations that relate to the construction and operation of work camps should be covered, that is for waste water, energy use, water use and waste disposal.*

Answer PCC: The sleeping accommodation for staff working on site will be located on a concrete lot, designated for storage of wood logs during operation of the plant. Office facilities during construction will be located where later the office building will be located. Nor□ur□ing municipality will provide the area with drinking water and electricity, but sewage from offices and sleeping accommodation will be pumped around 2 km into the sewage system of H□sav□k. All necessary licences and approvals for the installation of work camps will be required in cooperation with the Health Inspectorate, municipality and the Environment Agency of Iceland.

3 PROJECT INFORMATION - OTHER ALTERNATIVES

3.1 Sea water cooling

The second system alternative for cooling presented in this IEIS is the usage of seawater to cool down the heat exchangers like previously described in chapter 2.5. For this case a cooling tower will not be required, instead a pumping station will be built by the shoreline outside of PCC's lot and inlet and outlet pipes will be built. This alternative does not involve changes to other systems previously described in chapter 2.

For this alternative the sea water runs in a closed circuit and does not come into contact with any substances used in the process. The requirement of sea water for cooling is estimated at approximately 1,200 m^3/h for the first phase and 2,400 m^3/h for the second phase. The cooling increase of sea water temperature is approximately 15°C, but the increase of sea water temperature at the outlet will be below 2°C, see chapter 7.1. The intake of seawater will in this case take place through a filtration bed, where a trench is excavated into the coastline reaching to about 5 m below LWL. The trench is filled with blasted rock material and filter layers covering a core made of pit run. The filtration takes place inside the core, which is filled of blasted material screened for fines. To increase reliability, two independent trenches will be made. The concept of the seawater filtration is shown in **Figure 10**.

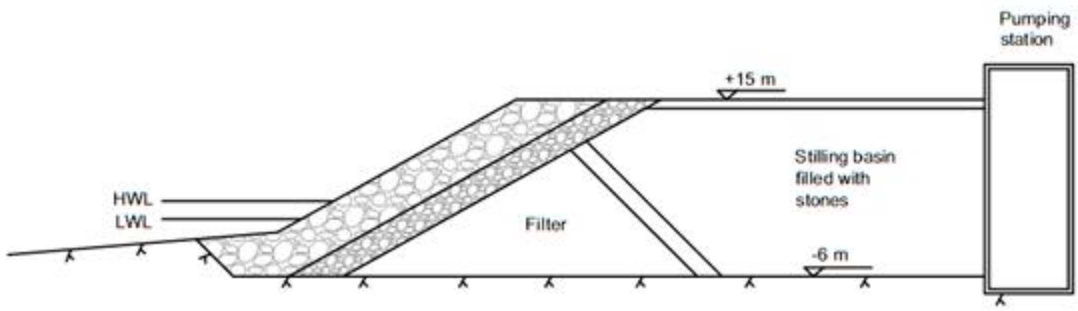

Figure 10: *Seawater intake with filtration (EFLA Consulting Engineers, 2012).*

The location of the possible seawater intake will be chosen in the final design of the Silicon Metal plant, but the most likely position is directly west of the furnace building, well outside the area of the coastline Bakkafjara that is listed in the Natural Conservation Register. The position of the outlet of warm seawater will be chosen with a sufficient distance to prevent all disruption to the seawater intake.

3.2 Zero-option

The zero-option entails that the PCC silicon metal factory will not be constructed at Bakki by Húsavík. The zero-option involves no jobs being created at the Silicon Metal plant, and no derived jobs related to the construction of the smelter or other service related tasks during the operation of the smelter.

Furthermore, the zero-option entails land not being disturbed because of buildings and areas surrounding of the plant.

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4 SITE LOCATION AND LAND USE PLANS

4.1 Project site

PCC SE’s project site is located in an industrial area at Bakki, in Húsavík town of Norðurþing municipality. In the 2010 – 2030 Municipal Plan for Nor□ur□ing, a 201 ha area at Bakki is reserved for heavy industries and related industries. The industrial area is situated approximately 3 km north of the town of H□sav□k. National Road no. 85 passes through the area. The si□e of the area west of the road is 143 ha and the area east of the road is 58 ha in size. PCC SE’s Silicon Metal plant will be situated in a southern part of the industrial area, west of the national road, see Figure 11 - **Figure 13**.

The northernmost houses of H□sav□k are situated around 1.2 km from the southern border of the industrial area. The area has been used for gra□ing until now, with agriculture practiced north of the planned industrial area. Rey□ar□ River delimits the northern border of the industrial area, with River Bakka□ running into it. Before construction work in the area begins, the courses of River Bakka□ and other brooks in the vicinity will be modified.

A large part of the planned industrial area is situated in a basin south of Rey□ar□ River, but the northernmost part of the area is lowland (8 m.a.s.l.) and elevates in the direction towards the national road. The land elevates rapidly to the east towards the slopes of H□sav□k Mountain. South of Rey□ar□ River the land descends rapidly, but then elevates towards Bakkah□f□i Cape (24 m.a.s.l.) only to descend again south of the Cape. The area is vegetated and the ground vegetation cover is nearly continuous. The area is characteri□ed by grasslands and heather fields and by wetlands in the basin, especially north of the River Bakka□ outside of PCC’s lot.

The area’s bedrock consists mainly of basalt. Tuff lies on top of the basalt and the soil consists mainly of glacier discharge and gravel. Soil covers the whole area, constituting a thick cover in the wetland basin, but thin cover in the vicinity of River Bakka□.

The plant will not be located within conservation areas under the Nature Conservation Act no. 44/1999. Protected areas (in Nature Conservation Register) are however located near the industrial area.

Figure 11: *A view of the industrial area from the north. The photograph is taken from a basin south of River Bakkaá .*

4.2 Existing plans

4.2.1 Municipal Plan

The current 2010-2030 Municipal Plan of Nor□ur□ing was confirmed by the Minister for the Environment in December 22nd, 2010. The industrial area and expected project site is presented in the urban outline plan, see **Figure 12**.

4.2.2 Local plan

A local plan is in preparation by the Nor□ur□ing municipality for parts of the industrial area at Bakki.

4.2.3 Regional Plan

Nor□ur□ing is a part of the 2007-2025 □ingeyjars□sla Geothermal Area Regional Plan, confirmed by the Minister of Environment on January 16, 2008.
The regional plan does not cover the industrial area in Bakki.

4.3 Property

The land at Bakki is the property of Nor□ur□ing municipality. The land has been used for gra□ing and for horses, in agreement with H□sav□k town.

4.4 Authorization

The following permits and authori□ations have to be acquired for the project:

- Nor□ur□ing municipality: The municipality provides development permits and building permits in accordance with the Planning Act no. 160/2010, on the basis of confirmed Regional and Municipal Plans and the NPA's reasoned opinion on a project's EIA.
- The Environmental Agency: An operation permit is issued by the Environmental Agency, based on the law on health and pollution control no. 7/1998, regulation no. 785/1999 on operation permits for industries that can lead to pollution and law no. 65/2007 on greenhouse gas emissions. A draft of the operation permit has been prepared together with this IEIS and the draft is shown in Annex 5.
- The Health Inspection of Northeast Iceland: Work camps are subject to authori□ation by local health inspectorates, based on regulation no. 941/2002 and law no. 7/1998.
- The Cultural Heritage Agency of Iceland: An archaeological audit has been carried out at the construction area. Should archaeological remains be in danger during construction or operation, a permit must be obtained from the The Cultural Heritage Agency of Iceland.

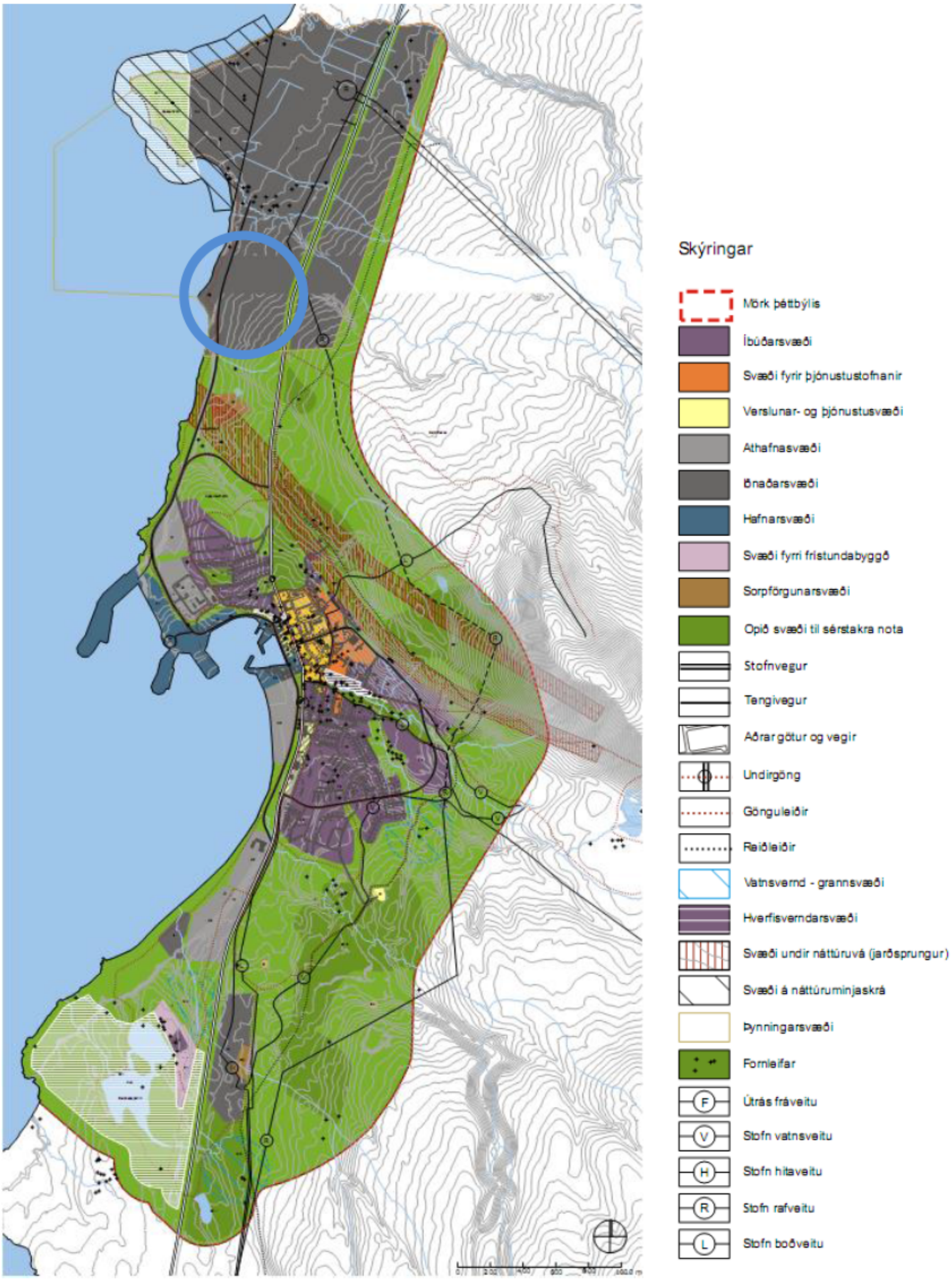


Figure 12: *From the urban master plan for the town of Húsavík in Norðurþing municipality. The industrial area at Bakki is shown in grey at the top of the figure. PCC SE's Silicon Metal plant will be located in the southernmost part of the industrial area, west of the national road, marked with a blue ring (from the 2010 – 2030 Norðurþing Municipal Plan).*

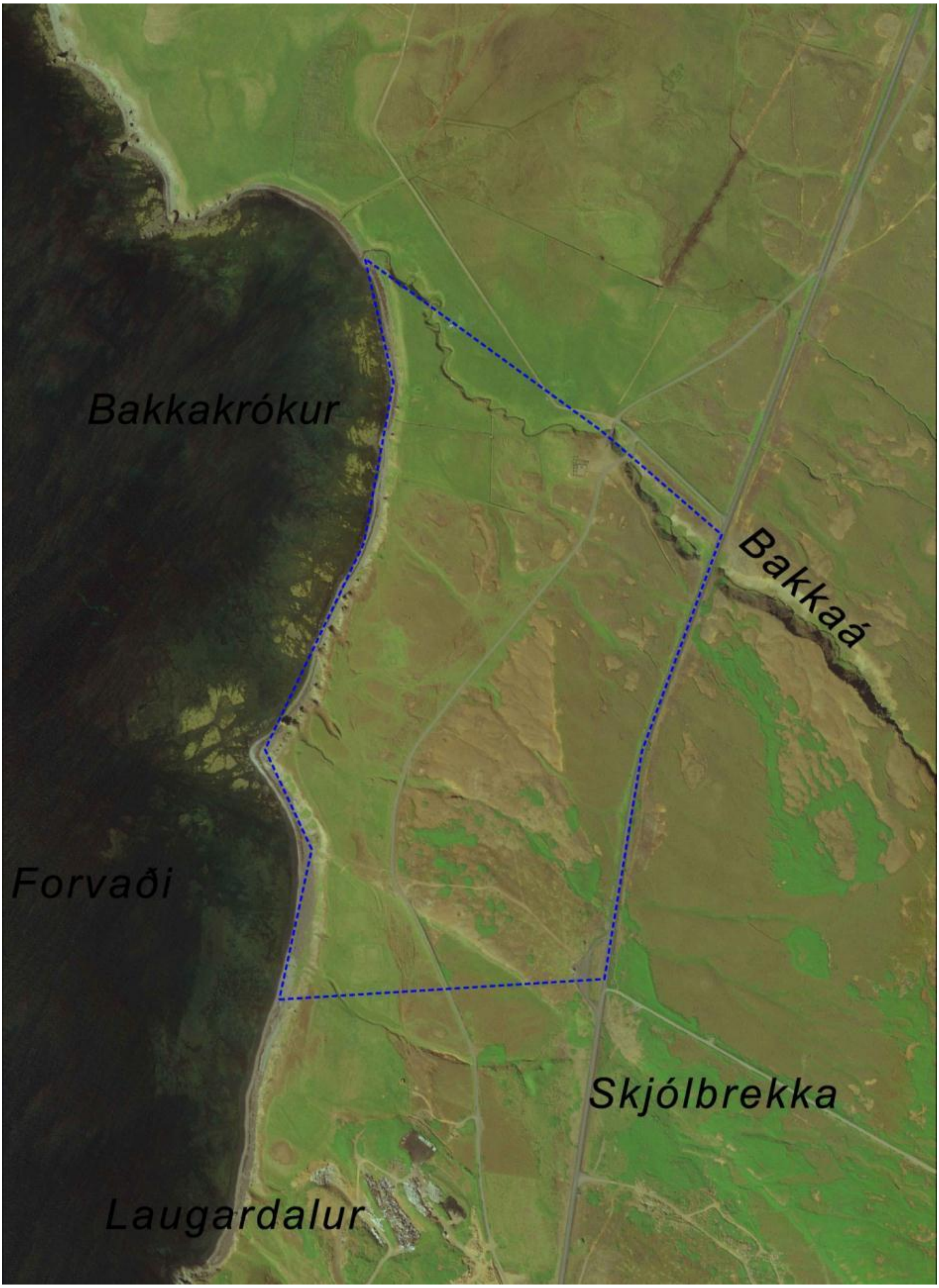


Figure 13: *An aerial view of the proposed project location at Bakki, north of Húsavík town. PCC SE's* Silicon Metal plant *will be allocated an approx. 22 ha area within the 45 ha area demarcated by the broken blue line, west of the national road and in the southernmost part of the planned industrial area, sea figure 3 in chapter 2. (Source: Loftmyndir ehf.).*

5 ENVIRONMENTAL IMPACT ASSESSMENT – SCOPE OF ASSESSMENT

5.1 General

Environmental impacts are discussed and evaluated in the Environmental Impact Assessment. Environmental aspects baseline and impact weight are discussed, based on expert statements on each environmental aspect.

5.2 Definition of the project's impact area

The project's area of impact is the area that is subject to environmental impacts caused by the project, both during construction and operation. During the environmental impact assessment, the impact area can be divided into three main categories:

- Direct impact on the environment: In order to assess direct impacts on flora, geographical formations and birdlife the area is defined to be about 100 meters outside the industry lot. This is a larger area than the defined construction area.. In order to assess emissions to air and noise, a larger perimeter is demarcated, based on calculations and models.

- Impact on landscape and visual impacts: A part of the EIA process is assessing the project's impacts on landscape and its visual impacts. The project area of impact for these factors expands to the north from the proposed plant. The plant can also be seen from the sea, the hills of Mt. H□sav□kurfjall and beyond.
- Social impacts: The boundaries of an impact area due to a project's social impacts can often be unclear. Húsavík and places in the town's vicinity are examined in this regard.

5.3 Criteria for the environmental impact assessment

Criteria for the environmental impact assessment area based on:

- References in laws and regulations, government strategies and international treaties.
- Specialist's analysis on the nature of the impact on special environmental aspects within the impact area.
- Comments and remarks from statutory consultees, stakeholders and the public.

The impact following the project is evaluated and given weight by comparing the characteristics of the impact to references for each environmental aspect. The results of the assessment forms a specific weight rating for every environmental aspect and the impact can be assessed between significantly negative to significantly positive. The weighted ratings are defined in The environmental impact assessment is carried out according to the Environmental Assessment Act no. 106/2000 and Environmental Assessment Regulation no. 1123/2005. The EIA procedure is equally carried out according to the NPA's guidelines on 1) Environmental Impact Assessment and 2) Classification of Environmental Aspects, Criteria, Characteristics and Environmental Impacts that are listed in **Error! Not a valid bookmark self-reference.**. Relevant criteria are used in assessing impact weight of individual environmental aspects, i.e. government strategies, international treaties, laws and regulations.

The IEIS details mitigation measures, where applicable, in regard to each individual environmental aspect under examination. Proposed environmental monitoring during the plant's operation is also presented.

Table 9. They are based on guidelines from the NPA from December 2005.

5.4 Environmental aspects examined in the EIA

The IEIS addresses environmental aspects that might be subject to significant impacts due to the project's realization, both during construction and operation. In the scoping document the environmental aspects considered to be relevant to the EIA process were presented. In the scoping process, existing documents and studies, laws and regulations were examined and primary stakeholders and relevant bodies consulted.
In the Environment Impact Statement focus will be on:

- Air quality and climate
- Noise
- Marine and coastal areas
- Flora
- Birds
- Landscape and visual impacts
- Archaeological remains
- Environmental impacts during construction
- Social impacts
- Risk and safety

The environmental assessment on these environmental aspects is provided in chapter 6 for alternative 1 and in chapter 7 for other alternatives.

The environmental impact assessment is carried out according to the Environmental Assessment Act no. 106/2000 and Environmental Assessment Regulation no. 1123/2005. The EIA procedure is equally carried out according to the NPA's guidelines on 1) Environmental Impact Assessment and 2) Classification of Environmental Aspects, Criteria, Characteristics and Environmental Impacts that are listed in **Error! Not a valid bookmark self-reference.**. Relevant criteria are used in assessing impact weight of individual environmental aspects, i.e. government strategies, international treaties, laws and regulations.

The IEIS details mitigation measures, where applicable, in regard to each individual environmental aspect under examination. Proposed environmental monitoring during the plant's operation is also presented.

Table 9: *Definitions of weight ratings used in the EIA process.*

Weighted rating	Definition
Substantial positive impact	The impact of the project or plan on the environmental aspect/s benefits the interest of a large number of people and/or has positive impact on an extensive area. The change or benefits resulting from the project/plan is usually permanent. The impact is often regional, national and/or global, but can also be local. The impact is in agreement with laws and regulations, general policy of the government or international treaties which Iceland is a member of.
Considerable positive impact	The impact of the project or plan on the environmental aspect/s do not cover an extensive area, however the area may be sensitive to changes, i.e. due to nature or archaeological remains. The impact can be positive for the area and/or positive for a large number of people. The impact can be permanent or in some cases reversible. The impact can be local, regional or national. The impact is in agreement with laws and regulations, general policy of the government or international treaties which Iceland is a member of.
Negligible	The impact of the project or plan on the environmental aspect/s is minor, with respect to the extent of the area and its vulnerability to changes, as well as the number of people affected by the changes. In many cases the impact is temporary and reversible to a large extent. The impact is in agreement with laws and regulations, general policy of the government or international treaties Iceland is a member of.
Considerable negative impact	The impact of the project or plan on environmental aspect/s does not cover an extensive area; however the area may be sensitive to changes, i.e. due to nature or archaeological remains. The impact can be negative for the area and/or cause disturbance or inconvenience for a large number of people. The impact can be permanent and in some cases irreversible. The impact can be local, regional and/or global. The impact can to some extent be in disagreement with laws and

	regulations, general policy of the government or international treaties Iceland is a member of.
Substantial negative impact	The impact of the project or plan on environmental aspect/s affects an extensive area and/or an area that is sensitive to changes, i.e. because of nature or archaeological remains, and/or depreciates the interest of a large number of people. The change or damage caused by the projects is usually permanent and irreversible. The impact is in disagreement with laws and regulations, general policy of the government or international treaties Iceland is a member of
Uncertainty	The nature and extent of the impact on certain environmental aspects is unknown, i.e. because of lack of information, technical deficiency or lack of knowledge. It may be possible to obtain information on the impact with further research or systematic monitoring.

5.4.1 Comments on the Environmental impact assessment and PCC's answers

Residents and land owners at Héðinshöfði comment: "*The EIA for the PCC Silicon Metal plant at Bakki, prepared by EFLA Consulting Engineers does not explain the environmental impact on the habitation and agriculture at Héðinshöfði. The farm houses are located around 2 km from the proposed Silicon Metal plant. We believe that the PCC construction excludes agriculture and habitation at Héðinshöfði for good."*

Answer PCC*:* It is the conclusion of the EIA for the PCC Silicon Metal plant that the direct impact of the plant is limited to the company lot. This also applies to emissions to air and noise (after considering noise protections). The results of dispersion of chemical emission show that their concentration is under the reference values of regulations and furthermore that the direction of the dispersion is not towards H□□insh□f□i. The noise assessment shows that the demands of the regulation are fulfilled at H□□insh□f□i 1 and 2 for the day and night period. In the conclusion chapter of the assessment of landscape and visual impacts it says that. "[…] seen from the national road and partly from the houses at Héðinshöfði 1 and 2 they structures will touch the skyline or reduce view. The reduction of view is low in general, but there will be an impact on view from those specific areas north of the plant. For the final design of the plant and choice of colour an effort will be made to reduce the visual impact from the plant as much as possible. Visible structures from this distance will not have an impact on residence or agriculture.

Residents and land owners of H□□insh□f□i further comment: *„The impact of emissions, visual pollution, noise- and light pollution is not taken into account. A demand is made for calculations that will take residential areas and agriculture into account that we believe will not be here in the future if industry will be built at Bakki."*

Therefore the demand is made that the impact will be assessed of visual pollution, sound level, light pollution that will occur for inhabitants at Héðinshöfði, during construction and when the plant is in full operation. The demand that measurements of those factors will begin today so allow comparison of the conditions for residents at Héðinshöfði today, during the construction period and after beginning of operation"."

Answer PCC: In the EIA for the Silicon Metal plant, the emission into air, noise as well as the visual impacts are assessed. Also the impact during construction was assessed and the mitigation measures described that will be implemented to reduce the impact and to increase the consideration for the neighbours of the construction area. When using flood lighting during construction care will be taking in reducing the impact on far surroundings as much as possible. During operation no special lighting of building is foreseen, other than lighting of gates, driving paths and walking paths within site because of security reasons. During design and installation of lighting care will be taken to reduce the impact outside of site as much as possible. Before beginning of the construction baseline research will be conducted to enable an assessment of the impact from the plant on its close surroundings during operation and to verify calculations conducted in the EIA.

The residents and land owners of Héðinshöfði comment: “*Information is requested for information on a comparable plant in terms of residential areas, agriculture, vegetation and animal life”.*

Answer PCC: ELKEM has operated a ferro-silicone plant at Grundartangi since 1978 with a yearly production capacity of around 140,000 tons per year. The industrial plants at Grundartangi perform environmental monitoring in accordance with an approved monitoring plan. A report with the results of the monitoring for 2012 can be found under: http://elkem.is/Files/Skra□0061082.pdf.

Furthermore, residents and land owners of H□□insh□f□i comment: *„Is it possible to say there will be no pollution in Tjörneshreppur municipality because of the PCC Silicon Metal Plant and what PCC’s measures to prevent this are?”*

Answer PCC: The results of the EIA are that the impact from the construction and operation of the Silicon Metal plant are limited to the lot and the nearest surroundings. Due to the distance from the municipal boarders and the nature and the magnitude of the impact it is assumed no pollution is expected in Tjörneshreppur municipality. PCC’s own measures include mitigation measures that are described in the IEIS and to insure that the operation of the plant is within requirements of the operation permit at all times.

Finally, residents and land owners at H□□insh□f□i comment: „ *The construction of the Silicon Metal plant at Bakki will reduce the life quality of residents of Héðinshöfði, also reduce property value and agriculture for the future. In the report says: In the view of the developer the environmental impact of the Silicon Metal plant is acceptable”. We doubt that such a claim can be supported. A confirmation is requested that the Silicon Metal plant will not reduce the living quality of residents and landowners of Héðinshöfði, cultivation, agriculture and ecosystem on the land will not be reduced and that the PCC Silicon Metal plant will not reduce the value of properties and buildings at Héðinshöfði during construction and when the PCC plant is in full operation.*

Answer PCC: The results of the EIA are that although the project has some impact on the environment, it is restricted to the lot boundary and close surroundings. The visual impact on the farm houses at H□□insh□f□i is considered to be considerably negative, permanent but reversible. Other impact of the Silicon Metal plant on H□□insh□f□i is considered negligible

6 ENVIRONMENTAL IMPACT ASSESSMENT – ALTERNATIVE 1

6.1 Air quality and climate

6.1.1 Assessment criteria

In the assessment of emissions from the production of silicon metal the references are limits set in Icelandic Ambient Air Quality Regulations

- Regulation 251/2002 on sulphur dioxide, nitrogen oxides, ben□ene, carbon monoxide, particulate matter and led in the atmosphere and information to the public.
- Regulation 410/2008 on arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in the air.
- Regulation 739/2003 on waste incineration.

6.1.2 Documents and studies

In the assessment of air quality the emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x), particle matter (PM10), persistent organic pollutants (POP), polycyclic aromatic hydrocarbons (PAH) and ben□o(a)pyrene (BaP). .According to information from SMS Siemag carbon monoxide (CO) is nearly fully burnt, and therefore CO emissions are considered to be insignificant and not further evaluated.

Emission values for sulphur dioxide, nitrogen oxides, particle matter and polycyclic aromatic hydrocarbons were provided by SMS Siemag. Emission values for ben□o(a)pyrene were taken from a German guideline on emission control from the production of i.e. silicon metal (VDI, 2010) and the emission value for persistent organic pollutants were taken from the BAT document (BAT, 2001) The emission values used in the study are listed in Table 10.

Table 10 *Emission values for pollutants from PCC.*

Substance	mg/m^3	per $t_{product}$	per year for 33,000 tons	per year for 66,000 tons
Sulphur dioxide (SO_2)	180	12,6 kg/t	416 tons	832 tons
Nitrogen oxides (NO_x)	100-250	7 - 17,5 kg/t	235 - 588 tons	470 - 1.160 tons
Particle matter (PM10)	5	0,84 kg/t	28 tons	56 tons
PAH (polycyclic aromatic hydrocarbon)	0,026	1,86 g/t	60 kg	120 kg
BaP (Ben□o(a)pyrene)□	0,0004	0,03 g/t	1 kg	2 kg
POP (persistent organic pollutants)□□	2,1 □10^{-10}	15 ng/t	0,495 mg	0,99 mg

□Emission values for BaP are taken from VDI report (VDI, 2010). Discharge limits for BaP in exhaust according to a German Regulation (TA-Luft) are 0,05 mg/m^3 but are referred to here as limit for Ambient Air Quality.

□□ Values taken from BAT (BAT, 2001). Value for PCDD/F is used, that also covers PCB (Polychlorinated biphenyl) and HCB (Hexachloroben□ene).

Wind measurements were provided by the Icelandic Met Office (Ve□urstofa □slands).for the weather station at Bakkah□f□i for the time period September 2002 to February 2009 and wind stability measurements between Bakkah□f□i and Mt. H□sav□kurfjall for the period September 2002 to May 2005. Figure 14 shows the wind rose for Bakkah□f□i.

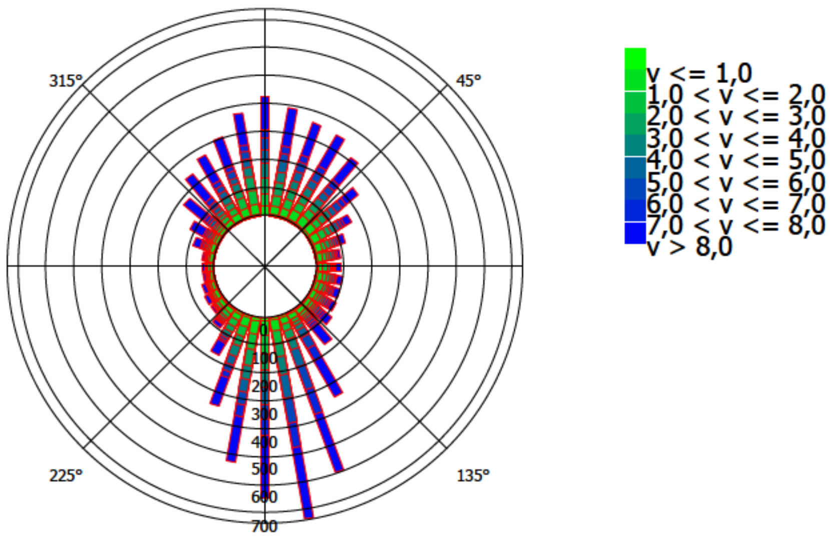


Figure 14: *Wind rose for Bakkahöfði by Húsavík 2002 - 2009*

Dispersion calculations were done with the use of a Gaussian dispersion model and are part of the software Soundplan 7.1. The weather station is located on the Bakkah□f□ peninsula north of the site and therefore considers the effect of the landscape south of it.

Requirements for ambient air quality outside of company sites and defined dilution areas are listed in Table 11.

Table 11: *Requirements for ambient Air Quality.*

Substance	Reference time/Value	Limit	Number of yearly deviations allowed	Regulation
Sulphur dioxide (SO_2)	1 hour (Human health)	350 □g/m³	24	251/2002
	24 hours (Human health)	125 □g/m³	3	
	24 hours (Vegetation) / (Human health)	50 □g/m³	7	
	Year and winter (Vegetation)	20 □g/m³	-	
Particle matter (PM_{10})	24 hours (Human health)	50 □g/m³	7	“
	Year (Human health)	20 □g/m³	-	“
Nitrogen dioxide (NO_2) and nitrogen oxide (NO)	1 hour (Human health)	200 □g/m³	18	“
	1 hour (Human health)	110 □g/m³	175	“
	24 hours (Human health))	75 □g/m³	7	“
	Year and winter (vegetation human health)	30 □g/m³	-	“
Persistent organic pollutant (POP)	Year	0,001 □g/m³	-	739/2003□□
Ben□o[*a*]pyrene	Year	0,001 □g/m³	-	410/2008
Polycyclic aromatic hydrocarbon (PAH)	Year	1 □g/m³	-	□

□No regulations apply for the concentration of PAH. Ben□o[a]pyrene (BaP) belongs to the PAH group of pollutants. Assuming that BaP is around 0,3-1,5□ of PAH, a high reference value of 1 □g/m³ is chosen as reference value.

□□No reference values area for POP in Icelandic regulations. POP contains amongst others doxine and furanes and the value used for the calculations covers both chemicals. Therefore the discharge limit for dioxin and furans in the exhaust from incinerators according to regulations nr 793/2003 used as reference values for the concentration of POP in the atmosphere

Information from SMS Siemag were used for the modelling of the source. Stack height was assumed 30 m, the stack volume 265,000 Nm³/h and the estimated gas stack temperature 220 □C. The design of the plant assumes one stack for each phase. Calculations on the release of particle matter also cover the raw material treatment (160,000 Nm³/h, ambient temperature), casting bay (144,000 Nm³/h, 65□C) and product handling (95,00 Nm³/h, ambient temperature). The total emissions of particle matter is 664,000 Nm^3/h. The ambient temperature was chosen as 10□C.

A conservative assessment on the concentration of nitrogen dioxide assumes that all nitrogen oxide (NO) reacts into nitrogen dioxide (NO_2)

Maps with the results of the dispersion calculations can be found in Annex 10.

6.1.3 Characteristics of impacts

Particle matter (PM10)

The results of the dispersion calculation show that the annual mean values and the 24 hours value are within the requirements of regulation nr. 251/2002 for ambient air quality, for both phases 1 and 2. The dispersion calculation results for the 24 hours value for phase 2 can be seen in **Figure 15**. Additional results for calculations can be seen in maps nr. 101, 102, 201 and 202 in Annex 10.

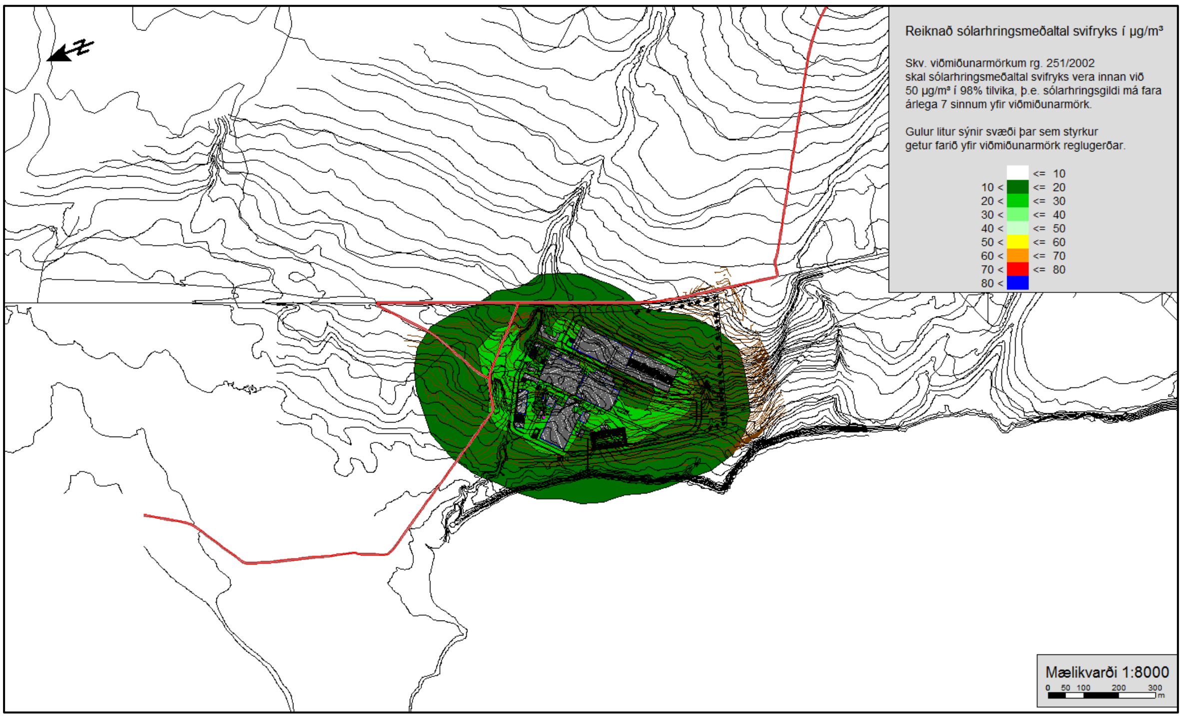


Figure 15: *24 hour mean concentration for particle matter for phase 2.*

Sulphur dioxide (SO_2)

The results of the dispersion calculation show that the annual and winter mean value, the 24 hours values for health and for vegetation and the 1 hour value are within the requirements of regulation nr. 251/2002 for ambient air quality, for both phases 1 and 2. The results for the annual and 24 hours values for vegetation, for phase 2, can be seen on **Figure 16** and **Figure 17**. The results of the dispersion calculation can be seen on air quality maps nr. 111-114 and 211-214 in Annex 10.

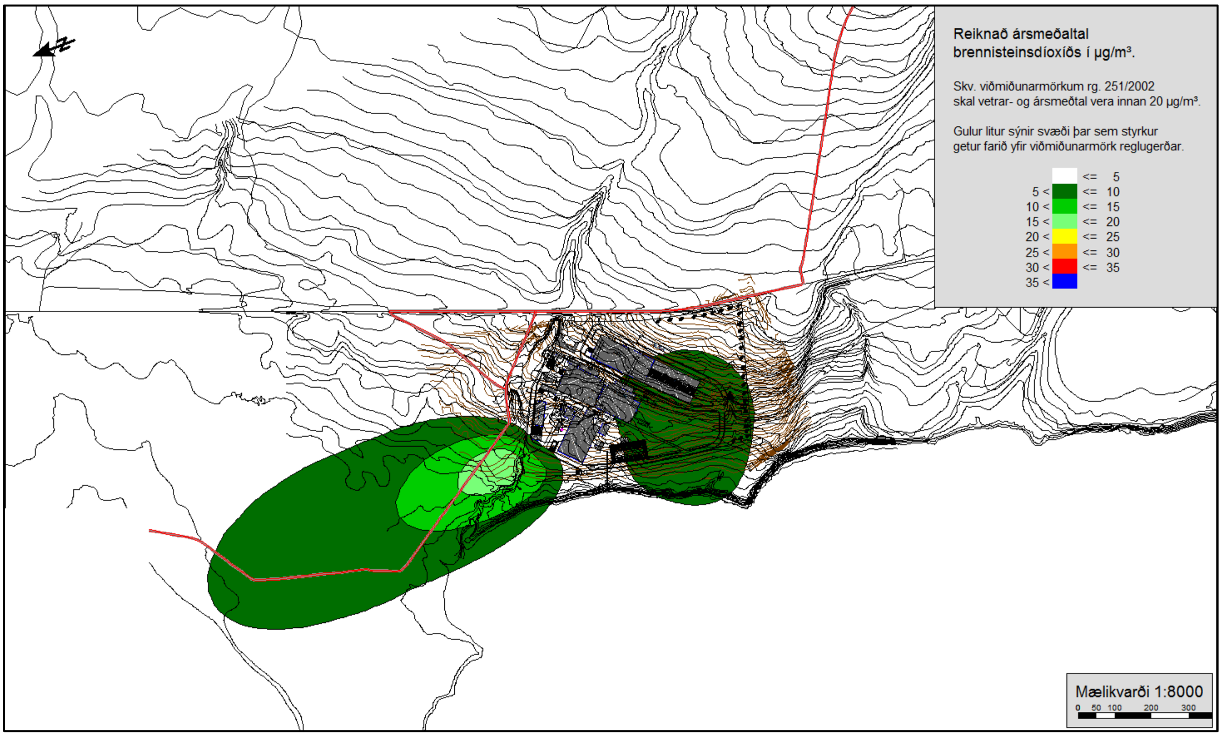


Figure 16: *Annual mean values for sulphur dioxide, for phase 2.*

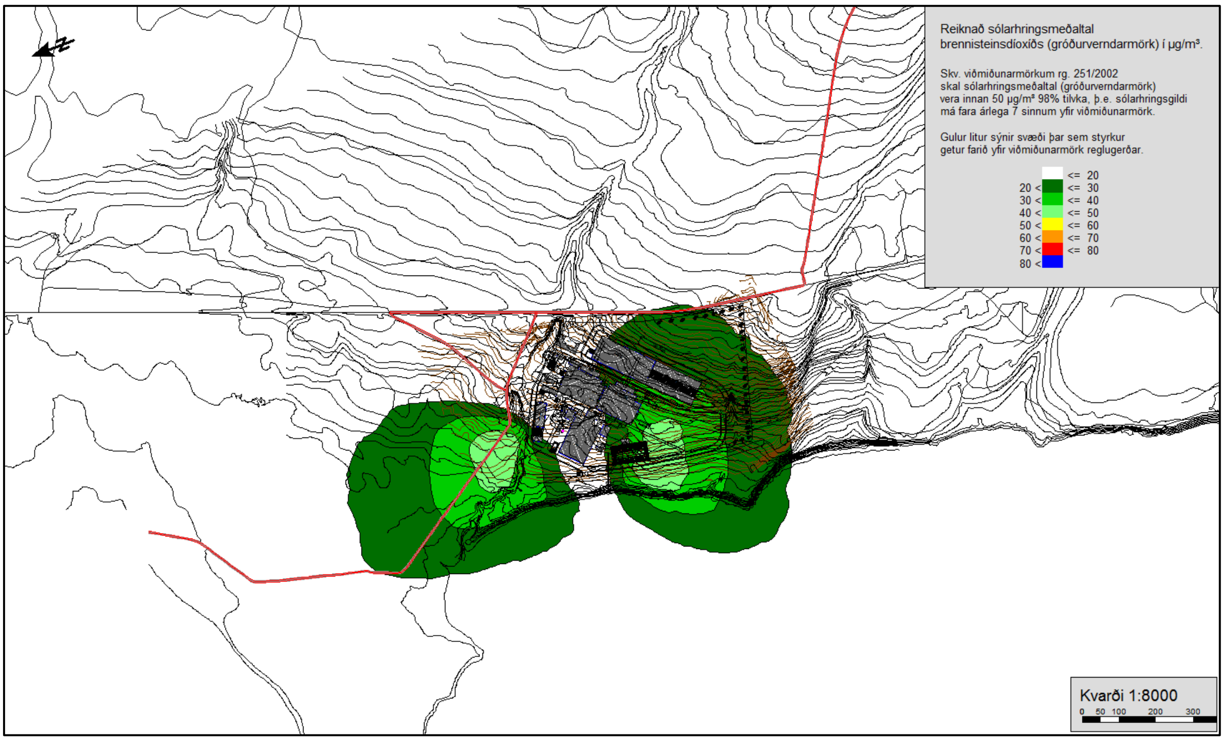


Figure 17: *24 hours mean values (for vegetation) for sulphur dioxide, for phase 2.* The concentration of sulphur dioxide is below the health requirement limits, the area is not both inside and outside the defined PCC plant boundaries

Since the concentration of sulphur dioxide is under the reference value for health in and outside of the lot, it is not believed to cause danger to men. The concentration of SO_2 is under the vegetation preservation value according to regulation 251/2002 at all times. Research shows that SO_2 in the atmosphere can have a long time effect on sensitive vegetation such as lichens and moss who have the lowest resistance against sulphur (value 15-30 □g/m^3) (Fri□rik P□lmason and Borg□□r Magn□sson, 1998) and cause long time change in the vegetation covers within the impact area, so that more vulnerable plants depart for others that are stronger. If the concentration of SO_2 in the atmosphere is high, SO_2 can oxidise to form SO_4 (sulphide) when coming into touch with static water. It is not assumed that the release from PCC will cause the concentration of sulphate in River Bakka to increase, because of the flow of the river.

Nitrogen dioxide (NO_2)

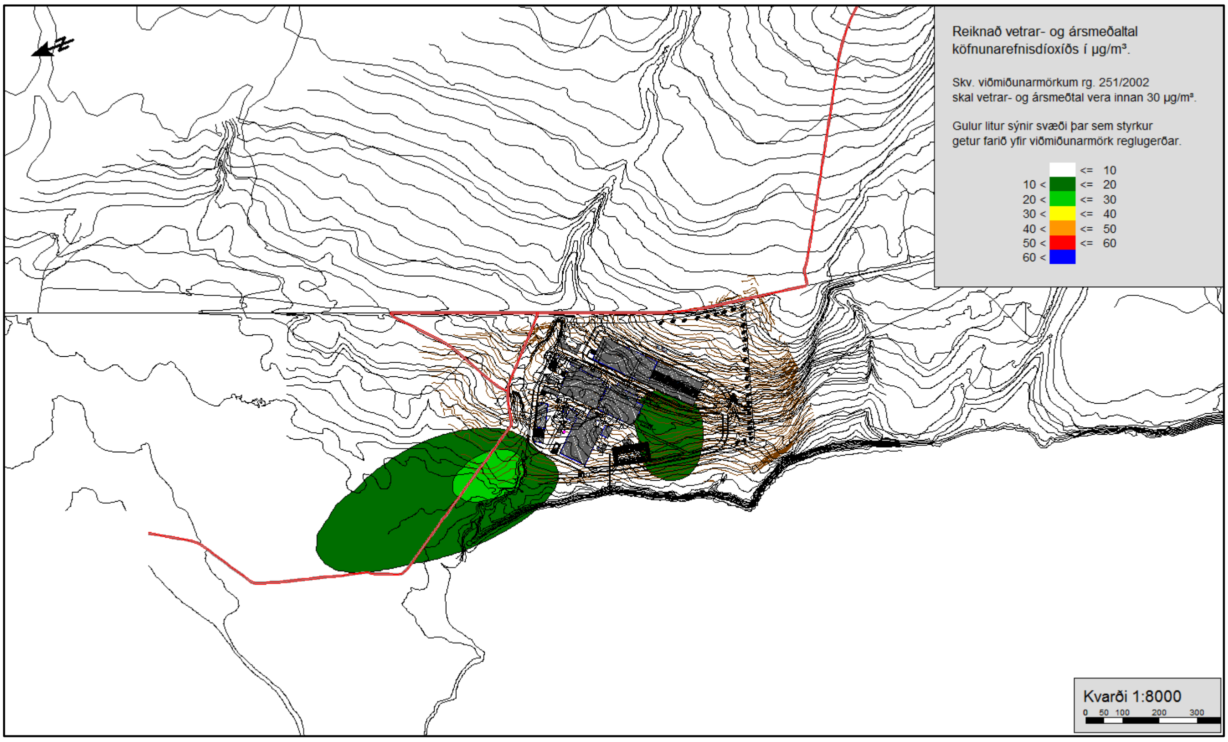


Figure 18: *Year and winter mean value of nitrogen dioxide according to phase 2*

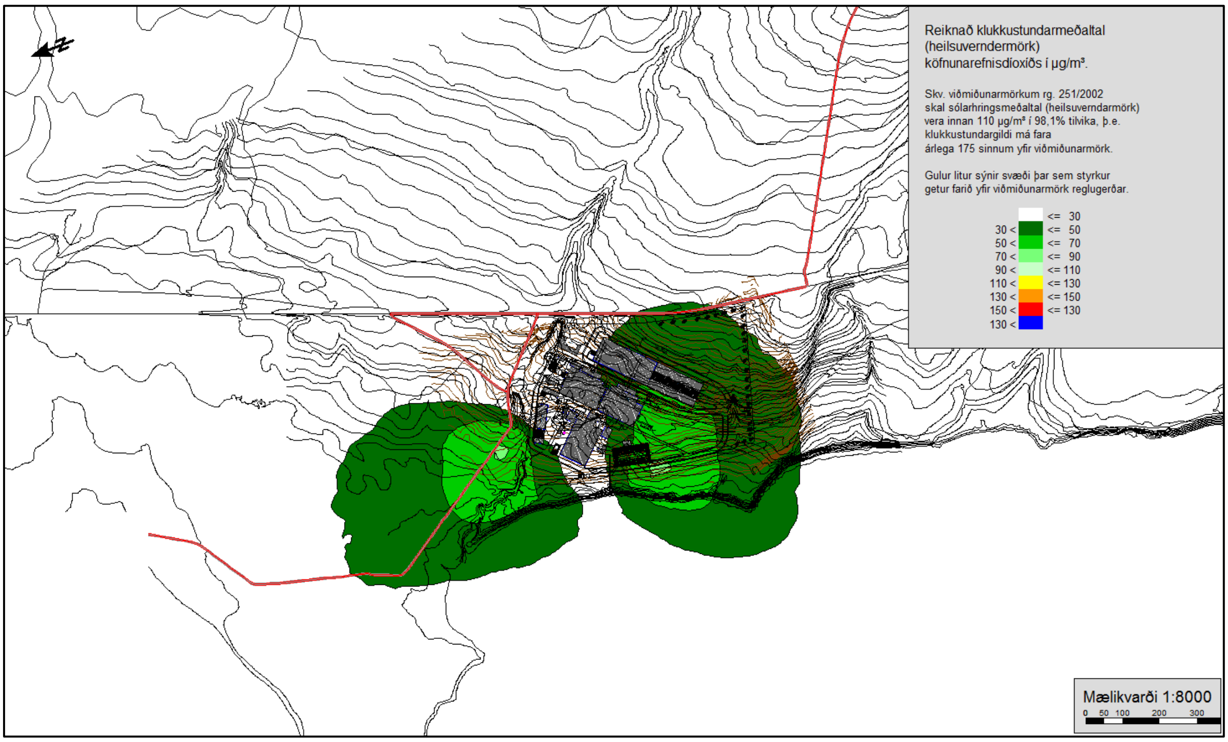


Figure 19: *Hourly value (110 µg/m^3) for nitrogen dioxide according to phase 2.*

The results of the dispersion calculation show that the annual and winter mean value, 24 hour value and 1 hour values are within the requirements of regulation nr. 251/2002 for ambient air quality for both phases 1 and 2, assuming a total conversion of NO_x into NO_2. The results of the dispersion calculation can be seen on air quality maps nr. 121-124 and 221-224 in Annex 10.

Persistent organic pollutants (POP)
The results of the dispersion calculation show that the maximum value for POP is 144 fg/m^3 (10^{-15} grams) for phase 2, which is within the reference value of regulation 739/2003 (discharge limits for incinerators). The concentration is lower than values that can be shown on maps.

Polycyclic aromatic hydrocarbons (PAH), Benzo(a)pyrene (BaP)
Results of dispersion calculation on the concentration of PAH and BaP show that the annual mean value of BaP is within the requirements of regulation 410/2008 for both phase 1 and phase 2. The calculation also show that the annual mean value is under the limit (1 g/m^3) that was used as reference value. Results of the calculation can be shown on Figure 20. Other results for the PAH are shown on maps 131 and 231 in Annex 10.

Table 12 shows calculated maximum values of the dispersion calculations.

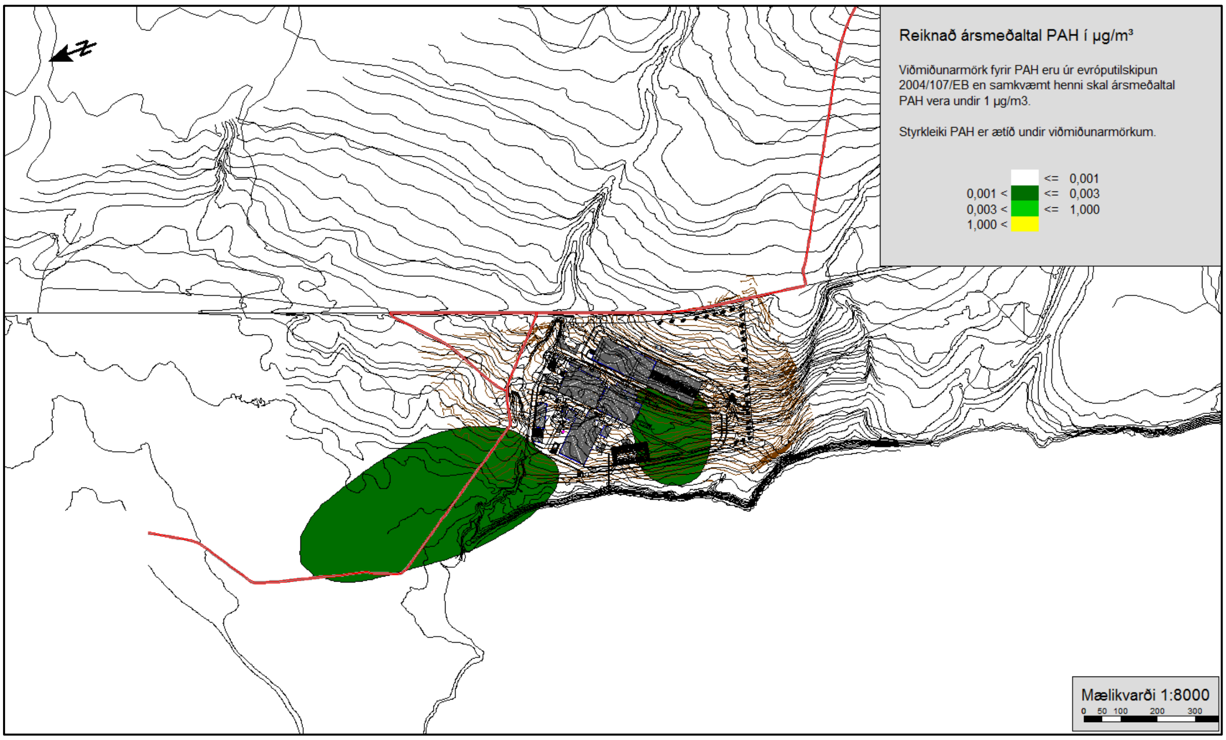


Figure 20: *Annual mean value PAH according to phase 2.*

Table 12: *Estimated maximum values of the dispersion calculation.*

Substance / **Reference value**	**Calculated maximum value for 33,000 – 66,000 tpa and stack release (30 m)**	**Calculated maximum value for 33,000 – 66,000 tpa and release through roof of the filter bag house (30 m)**	**Reference value**	**Reference to Annex 10**
Particle matter (PM10)				
Year	3,9 - 5,9 µg/m^3	4,1 – 6,1 µg/m^3	20 µg/m^3	101/201
24 - hours	31,0 – 34,0 µg/m^3	32,0 – 34,5 µg/m^3	50 µg/m^3	102/202
Sulphur dioxide (SO_2)				
Year and winter	10,3 - 17,9 µg/m^3	12,0 – 18,7 µg/m^3	20 µg/m^3	111/211
24 hours – human health	27,0 – 46,6 µg/m^3	28,0 47,6 µg/m^3	125 µg/m^3	112/212
24 hours – vegetation.	27,7 – 47,3 µg/m^3	31-50,6 µg/m^3	50 µg/m^3	113/213
1 hour	63,8 – 112,3 µg/m^3	65,0 – 114 µg/m^3	350 µg/m^3	114/214
Nitrogen dioxide (NO_2)				
Year and winter	14,4 – 24,9 µg/m^3	15 - 25,5 µg/m^3	30 µg/m^3	121/221
24 hours	42,0 – 65,8 µg/m^3	43 – 66,7 µg/m^3	75 µg/m^3	122/222
1 hour	46,7 – 66,0 µg/m^3	47 -71,0 µg/m^3	110 µg/m^3	123/223
1 hour	124,6 – 184,1 µg/m^3	130,8 – 190,3 µg/m^3	220 µg/m^3	124/224
Other substances				
PAH - Year	0,001 µg/m^3	0,002 -0,003 µg/m^3	1 µg/m^3	131/231
BaP - Year	2,88 ng/m^3	5,0 ng/m^3	0,001 µg/m^3	-
POP - Year	144 fg/m^3	150 fg/m^3	0,001 µg/m^3	-

EFLA Consulting Engineers have also evaluated the air quality when other methods for release of emissions are used instead of a 30 m stack. Two version were assessed, firstly the impact from three 8 m high stacks located on top of the roof of the filter bag house, that is ca. 35 m above ground. Secondly the impact from release through a 15 m long line source through the roof of the bag house. The results show that the concentration in the air remains under the reference values of the regulations when those methods are used.

The results of calculations for the annual mean value of sulphur dioxide when released through three 8 m high stacks and through the roof are shown on Figures 21 and 22 below. The results of calculation for other values are also under the reference values.

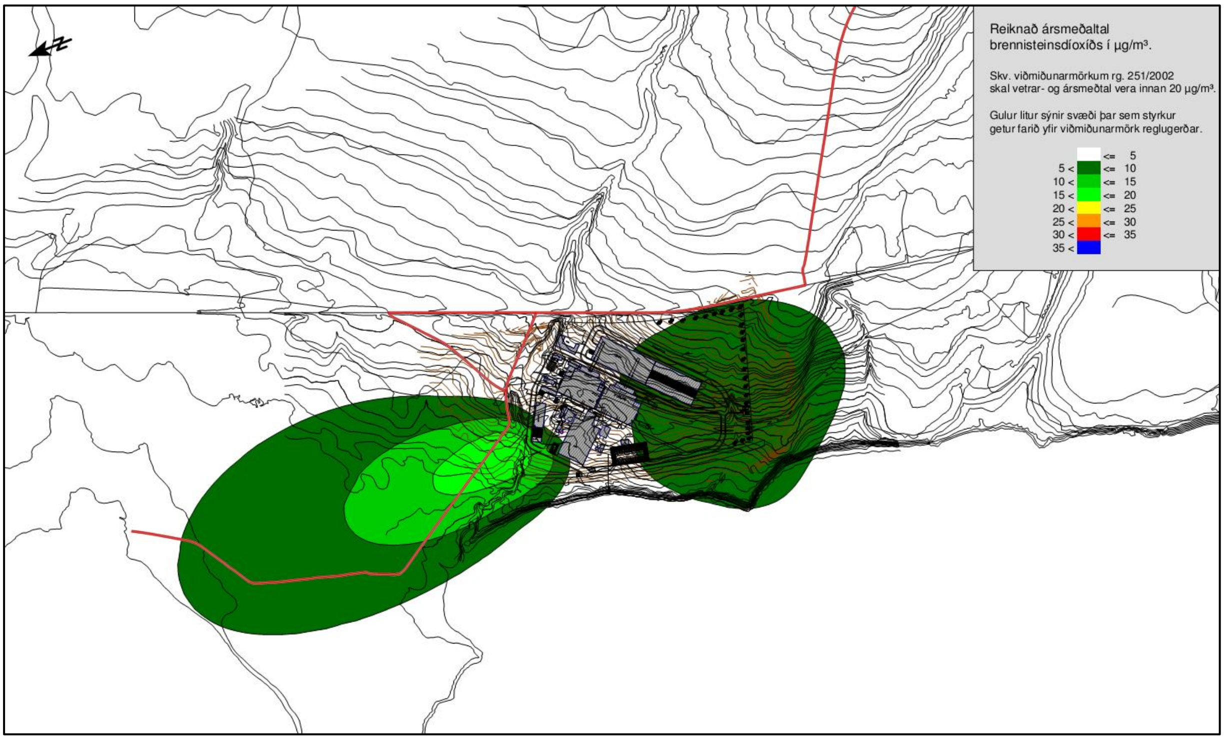


Figure 21: *Annual mean value of sulphur dioxide according to phase 2 for release through three 8 m stacks.*

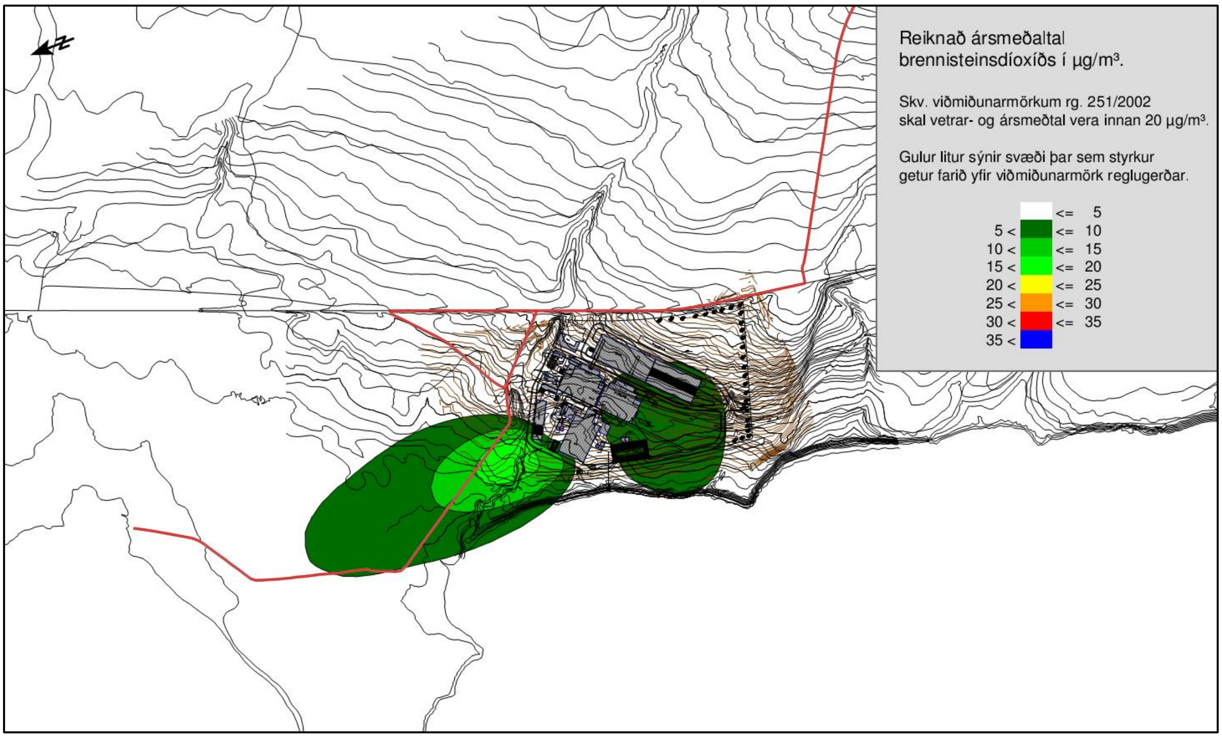


Figure 22: *Annual mean value of sulphur dioxide according to phase 2, for release through roof of the filter house.*

Release of greenhouse gasses

The operation of PCC at Bakki involves the release of carbon dioxide (CO_2) which acts as a greenhouse gas (GHG) in the earth's atmosphere, playing a major role in global warming and anthropogenic climate change. The general policy of the government of Iceland on GHG and climate change was set in 2007 and published in the government's action plan on climate change that was agreed on in 2010 (Umhverfisr□□uneyti□, 2010). The objectives are long term and they reduction in net greenhouse gas emissions by the year 2050 compared to net emissions in 1990, and a participation in a joint effort of the EU to reduce GHG emissions by 30□ until 2020.

In the general policy document of the government from 2010 it is, based on two scenarios of the EPA (UST), considered realistic to aim that the release of GHG from the aluminium and ferro alloys heavy industry will rise from the base year 1990 where the emission of GHG was 761 Gg. The release was 1,857 Gg in 2008 (□41□ compared to 1990) and expected to be 1,742 – 2,918 Gg in 2020 (□129 - 283□ compared to 1990). The policy document of the government expects that the changes in the release of GHG between the years 2008 and 2020 can be between a decrease of 115 Gg (- 6□) to an increase by 1,060 Gg (□57□). The release of the GHG carbon dioxide (CO2) from the operation of PCC will be approximately 181,500 tons (181.5 Gg) annually for the 1st phase and 363,000 (363 Gg) tons annually for the 2nd phase and is therefore within the expected increase of emissions until 2020.

Since 1992, Iceland has committed to the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC), who sets binding obligations to reduce emissions of GHG into the atmosphere. In the 1st commitment period of the Protocol Iceland made use of clause 14/CP.7 that allowed Iceland to increase GHG emissions by 1.6 tpa in the period 2008-2012 for new industry projects using the countries renewable energy sources. In 2011 Iceland has committed to participate in the 2nd commitment period (2013-2020) of the Kyoto Protocol. On the Climate Changes Conference of the Parties of the UNFCCC in Doha, Qatar, in December 2012 Iceland together with the EU member States and Croatia committed to reducing their total emission of 1990 by 20□ by 2020. Later negotiations between the nations following the conference will decide the commitments of each individual participating state.

Iceland will partly fulfil its commitments by participating in the EU trading system for emissions (ETS) which is the EU's main control instrument in the reduction of GHG. As of January 1st 2013 the ETS also covers stationary industry such as the production of silicon metal (according to Directive 2003/87/EC). Therefore other rules apply for the release of GHG from stationary industry than other release from Iceland since under the ETS stationary industry will be allocated release allowances from a pan-European source. In Iceland, the ETS System is a subject of law nr. 70/2012. PCC will apply for emission allowances to the Environmental Agency for the company's discharge of Greenhouse gasses during the operation as a new participant in the system.

Cumulative effects with future industrial installations at Bakki

Currently, the construction of two further metal producing plants is in planning at Bakki, the Thorsil silicon metal plant and the Saint Gobain silicon carbide plant. Due to the similar nature of the raw materials and processes in those installations, the main emissions to air from all three plants will be sulphur dioxide (SO_2); nitrogen oxides (NO_x) and particle matter (PM10). The operation of similar plants in the industrial □one creates a certain risk of cumulative effect of emissions and lead to situations where the requirements of ambient air quality cannot be met, which calls for a dilution □one for the area to be defined.

By the time of the submission of this EIA report information on emissions and locations could not be provided by Thorsil and therefore an estimation of possible cumulative effect of emissions is not possible. The current suggested site for Thorsil lies approximately 200 m north of PCC site. The most common wind directions in the area (measured at the Bakkah□f□i weather stations) are the north and south directions, with south directions being the prevailing wind directions. This means that emissions can possibly be distributed between the two sites with the risk of a cumulative effect.

Information could be provided by Saint Gobain on the expected emission from the operation. Because of a great uncertainty in the actual location of the source on site a reliable estimation of the possible cumulative effect cannot be done. Saint Gobain expects to emit around 1,400 – 1,900 tons of sulphur dioxide (SO_2) per year, which is around 1,7-2,2 times higher than emissions from the operation of PCC according to phase 2. Emissions of particular matter (PM10) are between 150-200 tons per year, or 6,2-8,3 times higher than dust emissions from PCC according to phase 2. Nitrogen oxide (NOx) emissions from Saint Gobain are expected to be less than 60 tons, or 5□ of the NOx emissions from PCC according to phase 2. There are insignificant carbon monoxide (CO) emissions from the operation of PCC and therefore no risk of cumulative effect.

The main wind directions that can possibly lead to cumulative effects between PCC and Saint Gobain are N-NA and S-SW directions, with the north directions being more frequent. Considering the amount of emissions, the risk is highest for SO2 and also considerable for PM10 due to the rather strong source from Saint Gobain.

However due to the uncertainty of information on the sources and locations of the operations of Thorsil and Saint Gobain no detailed analysis on the risk of cumulative effect arising can be made at this stage.

6.1.4 Mitigation measures – monitoring

No mitigation measures are needed. PCC will assign 3rd party with point measurements of the ambient air quality at the site premises on a regular basis and also within site on points that might be frequently visited by visitors (i.e. visitor parking lot). Main emphasis will be put on measurements on the northern side of the lot where the most impact is expected. Base line studies will be conducted on the concentration of sulphur dioxide in grass and in leaves in designated areas and the possible increase in the concentration will be assessed every other year. PCC will furthermore assign 3rd party with regular sulphate and pH measurements in River Bakka□. PCC will participate in monitoring programmes in the area on possible impact to the environment that can be related to the operation of PCC.

6.1.5 Conclusion

The results of the air dispersion calculation and the evaluation of the air quality show that an increase in emissions but that the ambient air quality for sulphur dioxide, nitrogen dioxide and particle matter outside of the PCC site, will meet the requirements of regulations. The emissions of persistent organic pollutants (POP), Polycyclic aromatic hydrocarbons (PAH) and Ben□o[a]pyrene (BaP) are very low and well within all limits. The release of carbon dioxide from the operation will increase the emissions of Greenhouse gasses from Iceland, but is within the limits of realistic increase in release until 2020. According to current plans two further operations are planned in the area. Due to the closeness of the plants a cumulative effect of emissions is possible. This can only be studied fully when information on all operations are available. The impact following the emissions from the operation of PCC are considered to be ***negligible***

6.1.6 Review and comments on Air Quality and PCC‘s answers

6.1.6.1 Comments of The Environment Agency of Iceland

The comments of the Environment Agency of Iceland states: „*Table 10 shows the airborne emissions of different air pollutants. The table reveals a total release of sulphur dioxides (SO_2) for annual production of 66,000 ton of 832 ton. The Agency does not comment on the amount, but points out that it might be useful to provide information on the prerequisite for the release calculations, that is the sulphur content of each group raw materials and the total amount of raw materials.*

Answer PCC: Based on the amount of raw materials and the estimated composition the emissions of SO_2 were estimated based on the following:

Table 13: *Estimated discharge of sulphur dioxide (SO_2).*

kg S/t$_{Si}$	**kg/t$_{Si}$**	**%S**	**kg S/t$_{Si}$**
Quart□ite	2,400	0.01	0.24
Wood chips	1,350	0.01	0.14
Coal	1,250	0.45	5.63
Electrodes	100	0.45□	0.45
		Total	6.45
Discharge SO_2 (for. 66,000 t annual production)			□850 ton

Furthermore, it says in the comments from The Environment Agency of Iceland: „ *The Environment Agency also requests information on dust pollution from the handling of raw materials where appropriate, in the BAT for this type of activity it is expected to be a loss of up to 0.2% from material handling.*

Answer PCC: Dust creation from handling of raw materials that can escape from the handling of raw materials has not been calculated. However, the dust creation is estimated to be negligible, since the coals are washed before being loaded on ship, to avoid fines in the material. Therefore the coals are relatively moist when unloaded in H□sav□k. If any dust pollution will be noticed when unloading of raw materials they will sprayed with water to avoid dust pollution

Also the Environment Agency points out that: " the third draft of a new BAT and □BAT conclusion□ has been issued for the aforementioned industries. The Agency requests the operator to account for if he can meet the conditions and limits set out in the BAT conclusions draft (see chapter 14 in the BAT report *http://eippcb.jrc.es/reference/BREF/NFMbw_17_04-03-2013.pdf).”*

Answer PCC: According to information from the furnace producer, SMS Siemag, the operation and monitoring of the Silicon Metal plant will be accordance with the conditions and limits set out in the draft BAT conclusions.

Furthermore it says in the comments of the Environment Agency: „ *The Environment Agency considers it desirable to discuss the topic of dust pollution during construction and to explain possible mitigation measures to reduce dust pollution during construction. Dust pollution during the construction of the plant can be significant, even greater than emissions from the plant itself when it is in full operation. Around the world mitigation measures are being engaged during construction, and as an example, the US contractor Bechtel defines dust as the main environmental impact from construction“.*

Answer PCC: Chapter 6.8 discusses dust pollution during construction and describes mitigation measures to prevent dust pollution during construction. It states that if a new industrial road (connection road) will be in operation all traffic during the construction will be on that road, which will prevent traffic related dust pollution in the urban areas. Also that dust pollution will be prevented by covering the loads of trucks. On the construction site irrigation will the applied if there is a risk of dust pollution arising

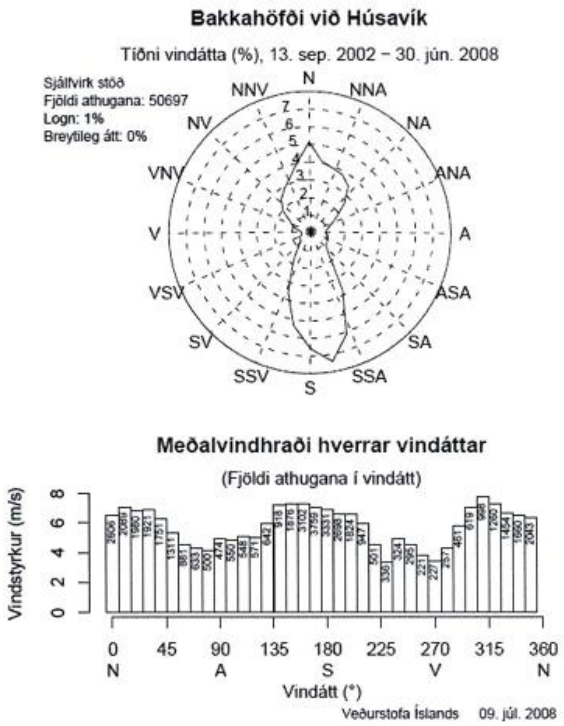
The Environment Agency points out in its comments: „*The introduction of the silicon metal plant will increase air pollution. The air pollution is mostly confined to the area close to the plant and the calculated emissions will not go over the reference values of Icelandic regulations. Some values can however go near to the regulatory limits. It is expected that the annual mean value of SO_2 can go up to 17.9 µg/m^3 but the reference value for the annual* *mean value is 20 µg/m^3. No measurements exist on the current concentration of SO_2 in the area, but for reference the annual mean value of SO_2 on Grensásvegur road in Reykjavík has been between 2-4 µg/m^3. It can be assumed that SO_2 can be clearly measured in the town of Húsavík, but according to available data, it is not expected that air pollution levels are above reference levels of regulation 251/2002. In that regulation are the 24 h health limits for SO_2 125 µg/m^3. Those are the same values as in European Air Quality Regulations. The Environment Agency points out that the World Health Organization (WHO) issued in 2005 new limits for guideline values for Air Quality http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf There the WHO defines the suggested 24 h reference value for SO_2 as 20 µg/m^3. Those values are considerably more stringent than in Icelandic and European regulations where the 24 hour value is set to 125 µg/m^3. No decisions have been made if rules in Europe will be tightened in view of the WHO guideline values. The presented data do not suggest that the WHO guideline values will be exceeded in the town of Húsavík.*

Finally, the Environment Agency comments*: „On page 33 of the IEIS discusses the potential cumulative effect from the discharge of other factories that are in the pipeline at Bakki, such as the possible Thorsil and Saint Gobain plants. It is stated that there are still insufficient data from other potential operators to calculate the potential cumulative effect. In relation to other planned development in the area the Environment Agency points out the need for further study of potential cumulative effect of polluting substances, especially SO_2 "*

Answer PCC: Potential cumulative effect is assessed in the EIA based on available data at the time of the assessment. In order to evaluate the cumulative effect, PCC will provide other parties who pursue development in the area with data, if and when it comes to assessment of Air Quality for the respective project.

6.1.6.2 Comments of the Icelandic Met Office

The Icelandic Met Office comments: "*In chapter 6.2.1 in the IEIS Figure 14 shows a wind rose for Bakkahöfði for the period September 2002 to February 2009. This wind rose is unreadable as presented here. A large and empty ring is in the middle and the wind rose is lacking a scale that shows the wind direction or wind speed. The wind rose below which is in the possession of the Met Office (for a slightly shorter period), shows that calms are only around 1% of the time at Bakkahöfði. The most common wind directions are from S and SSE directions, but also wind from N is rather frequent. Winds blowing from clear E or W are very rare at Bakkahöfði. Also the column bar chart below the wind rose shows that winds from S and SSE are the directions with the strongest wind speeds, although winds from NW can be rather sharp in the few occasions it occurs.*



Answer PCC: At the beginning of the assessment process the Icelandic Met Office was consulted on which date should be the base for the Air Quality calculations. Available observations from the last few years were analysed and the suggestions from the Met Office followed which data was to be used. The wind rose used for the calculations and shown in the IEIS was made using measurements from the Met Office at Bakkah□f□i. And updated image with enlarged wind rose and wind classes is now presented in the EIS

The Met Office further comments: „*The same section says that the emission calculations of the emissions of particulate matter were investigated the air temperature was selected 10°C. This is a much higher temperature then the mean temperature measured in weather stations in the area. At Mánárbakki the annual mean temperature is 3.9°C and 3.3°C at Raufarhöfn. The highest temperature ever to be measured at Bakkahöfði since 2002 is 25°C. Therefore it can be assumed that there might be some error in the emission calculations, but the exhaust velocity (and exhaust distance) depend on the temperature difference of the exhaust and the air around it. If the difference is small the emissions travel a shorter distance than if the difference is great. Therefore it can be assumed, that the exhaust travels a longer distance at temperatures around freezing point or just above it, than when the air is 10°C".*

Answer PCC: Air temperature in the EIA refers to heat of the exhaust from the handling of raw materials and from crushing and packaging of products which is connected to the outside temperature to some extent. In the modelling a constant exhaust temperature of 10□C was chosen. The calculation model does not calculate with the outside temperature, but measurements of the vertical temperature gradient between Bakkah□f□i and Mt. H□sav□kurfjall were received from the Icelandic Met Office for the period September 2002 – September 2003 and were used along with wind measurements from Bakkah□f□i for the distribution calculations.

Furthermore the Met Office comments: *"Chapter 6.1 does not seem to explain the impact on Air Quality from transport to and from the plant. It is necessary to provide estimations on this matter and to estimate the impact of transport on climate."*

Answer PCC: The total transportation of raw materials and products between the harbour area and the plant are on average 243,300 tons for 33,000 tons production capacity and 486,600 tons for 66,000 tons production capacity. Assuming slow moving trailer trains with 85 tons capacity that drive on the industrial road (3 km), around 2,900 trips can be assumed annually (for 33,000 tons). Using values from Life Cycle Analysis database (GaBi 6) it can be assumed that the emissions from transport are around 79 tons CO_2 – equivalents per year.

The Met Office also comments*: "In Chapter 6.1.3 it is necessary to provide clearer information on the calculated values and the concentration of pollutants according to dispersion models and to explain them clearly in the text of the report. It is of importance to explain which concentration is the highest mean concentration of each time. Air Quality maps of the dispersion cannot stand alone as information on this aspect. It is necessary to provide the error margins of such calculations"*

Answer PCC: The highest calculated concentration and reference values are in Table 12, that shows the highest average values (percentiles), as they are defined in regulation 251/2002, for 33,000 and 66,000 ton production capacity and their comparison to the reference values of the regulations. The model calculations all assume constant operation of the plant, all days of the year. Therefore the release into the atmosphere in the model is constant over the whole time, without changes in emissions as they would be shown in measurements on site. The aspects that influence the accuracy of the dispersion calculations are mainly the quality of the available data, such as the accuracy in the digital ground model, weather measurements and information on the source. However, it is not possible to quantify the error in the factors. The dispersion model is considered to give a good idea of the situation in the area during the operation of the plant. The dispersion calculations will be verified by monitoring and the results of the monitoring will be responded to if necessary.

The Met Office furthermore comments*: "In those cases where the concentration is close to the reference values, they need to be clarified further, such as the maximum value of the dispersion calculation, highest possible concentration, under what circumstances/conditions they might arise and the frequency of such situations. This applies i.e. for the 24 h mean value of particulate matter. The calculated winter and year mean values, 24 h mean value and hourly mean value of nitrogen dioxide for 66,000 ton production capacity also seems to be close to the reference values, and therefore the maximum values should be further clarified. The scale on the Air Quality maps needs to be further explained, since it is hard to realize the meaning of the green colour code in the maps."*

Answer PCC: The calculated maximum values for the values mentioned above are in all cases below the reference values of regulation nr. 251/2002, see Table 12. The colour code of the maps indicates the area between equal concentration lines, which is the calculated strength within each area, is in the same range as showed on the scale with each individual map. White and green colours indicate areas where the concentration of pollutants is below or equal to the reference values. Yellow colour indicates areas where the concentration can go over the reference values. Higher concentrations are then indicated with orange, red and blue colour. This colour sequence is used to enable a better recognition of areas where the concentration is above the reference values. If an Air Quality map is only with green colour then the calculated concentration is always below the reference values.

Also the Met Office comments that*: " According to Air Quality maps in Annex 8 [comment EFLA: Annex 10] the calculated 24 h mean value for 33,000 tons production capacity seems to be close to the reference values. The calculated 24 h mean value for 66,000 tons production capacity seems to have a similar distribution to the north, but even not achieve the same strength, that is not get close to the 40 µg/m^{3}limit value. This needs to be clarified."*

Answer PCC: The highest calculated 24 h mean value for particulate matter is 31.0 □g/m^3 for 33,000 ton production capacity (1st phase) and 34,0 □g/m^3 for 66,000 tpa production (2nd

phase) capacity as can be seen in Table 12. The reference values of regulation 251/2002 for the 24 h mean value is 50 g/m^3, so therefore the calculated values fulfil the requirements of the regulation. The images of the distribution phase 1 and phase 2 are unlike, since the source for phase 2 lies south of the source for phase 1. Furthermore, it is stressed that monitoring during operation will confirm the results of the dispersion calculations.

The Met Office comments further*: "Table 12 in Chapter 6.1.3 shows the estimated maximum values of the Air Quality Assessment. The numbers seem to be what can be expected from average values, and not maximum values. It would be desirable to present both numbers and the error margin."*

Answer PCC: The values in Table 12 are calculated maximum values for annual mean values, 24 h mean values and hourly mean values. Individual maximum values were not calculated.

Finally, the Met Office comments: "Finally chapter 6.1.3 states that other methods of discharge were evaluated then release through 30 m stack. It must be clear if those methods are part of the EIA in this report. If so, then similar information has to be presented as for the 30 m stack."

Answer PCC: According to information from the furnace manufacturer, SMS Siemag, the expected height of release from the filter house is between 30-32 m above ground. Calculations were release through the top of the open bag house in 30 m height. The results shows that this method of release increases the calculated values, but also that the impact is negligible, that is that the operation fulfils all requirements of the regulations. Table 12 in the Environmental Impact Statement (EIS). Table 12 in the EIS shows updated values with assessment of other form of release than was initially presented in the IEIS. Air Quality maps showing the results of the calculations are shown in Annex.

6.1.6.3 Comments from Verkís Consulting Engineers

Verks Consulting Engineers comments: *"A letter from The National Planning Agency, dated September 17, 2012, the Agency requests a joint assessment of the impact of the concentration of pollutants due to airborne emissions from 3 parties preparing the production of silicon products in the industrial zone at Bakki by Húsavík. Verkís, on behalf of Saint Gobain sent Efla on behalf of PCC all necessary information on the estimated emissions from the proposed plant of SG together with the coordinates of the outlet. Therefore it is wrongly stated in Chapter 6.1.3 on page 33 in the IEIS which is now in presentation, that PCC received data which shows the location of the lot, but uncertainty about the location of the plant within the lot hinders a reliable estimation of cumulative effects. Efla did not request any further information than those who were sent."*

Answer PCC: On November 22, 2012 Verks sent EFLA and email containing a table on the amount of emissions as presented in the Scoping Document for the proposed Saint Gobain plant.

Same email also contained a description of the outlet and a drawing file (.dwg) with the location. The e-mail from Verkís states that the coordinates of the outlet are "very rough" and that the height of the surface/lot is "an estimate". A telephone call with the author of the local plan (Mannvit Consulting Engineers in Hsavk) stated that work on the local plan of the area was not completed and that the final lot boundaries and locations within lots were not definitely determined.

With regards to the uncertainty described above it was decided that necessary requirements were lacking to assess the possible cumulate effect between PCC and Saint Gobain in another way than was done in the IEIS. In early January 2013 Verks inquired about the progress of the cumulative assessment and in the same telephone call Verks was informed about the progress and an explanation given why the option was chosen. Verks made no comments. In the same conversation no indications were made by Verks that new information on the more precise location of the outlet was available. It should be pointed out that it is the responsibility of each respective company to assess the impact of airborne emissions from its operations and thereby to take into consideration the information presented in this Environmental Impact Assessment on the impact of airborne emissions from PCC's silicon metal plant.

6.1.6.4 Comments from residents and landowners at Héðinshöfði

Residents and landowners at H□□insh□f□i comment: "*Which weather studies are used? In 2010 weather stations at Bakki were stopped [EFLA comment: measurements were discontinued] after ca. 7-8 years and after 3 years at Héðinshöfði. The weather station in the harbour area has been inactive for a long time. It's unacceptable that these measurements are cancelled, wind direction and weather conditions have a great influence on our environment in terms of exhaust from the proposed plants, including PCC. The undersigned demand that those weather stations will be taken into operation immediately and not only old data used from those stations that have not been in operation in recent years.*"

Answer PCC: The data used comes from wind measurements conducted by the Icelandic Met Office at Bakkah□f□i for the period September 2002 – February 2009. In preparation of the assessment, the Icelandic Met Office was consulted on which weather station was best suitable for the calculations and it was the conclusion of the meteorologists that measurements from Bakkah□f□i would describe better the wind conditions in the area, then other nearby stations. The developer assumes that no changes have occurred in the area after the measurement period ended that might cause changes in the wind scenario in the area.

Furthermore, residents and landowners at H□□insh□f□i comment: "*What is the exhaust of machinery and vehicles […] after the beginning of productions and what will be the impact on residential areas, land cultivation and agriculture in Héðinshöfði?*"

Answer PCC: All transportation between the harbour area and the PCC site will be through the industrial road that runs along the coastline, far away from H□□insh□f□i, except in those exceptional cases when the transportation will be through the public road to H□sav□k, as is described in the EIS. Neither regular transportation through the industrial road, nor temporary transport through the public road will be directed by the H□□insh□f□i farms. Possible regular traffic passed H□□insh□f□i that can be connected to the plant, is the driving of staff residing north of H□□insh□f□i to work.

6.2 Noise

6.2.1 Assessment of criteria

The Icelandic regulation on noise nr. 724/2008 requires that sound level from traffic and industry does not exceed a given value, depending on the circumstances. Sound level from traffic should not exceed 55 dB(A) in front of windows in residences located in a residential area and where people dwell within premises. In front of windows (that can be open) in residences, located on shopping, service and central areas the sound level may reach up to 65 dB(A).

Greater demands are made on the sound pressure level from industry in residential area, and then the requirements are divided into three periods of time, see Table 14.

Table 14: The criteria from the Icelandic regulation on noise nr. 724/2008 regarding noise from industry in front of a window of a residence in a residential area.

Period of time	Criteria (L_{Aeq})
Day (07-19)	50 dB (A)
Evening (19-23)	45 dB(A)
Night (23-07)	40 dB(A)

The Icelandic regulation on noise also requires a certain sound level criteria, from industry in industrial areas is met at the outside wall of houses. The criteria are defined at the boundary of industry site since it is possible that neighbouring houses are built directly at the boundary. This is also done to avoid possible cumulative effects from many operations. Sound pressure level on boundaries of industry sites shall not exceed 70 dB(A) over the day-, evening- and night period

6.2.2 Documents and studies

Noise emission from the PCC Silicon Metal plant can be divided into two parts. From the operation of the silicon smelter and from harbour activities related to the plant in form of unloading, loading and transport to and from the plant.

A model of the noise propagation from the factory site was conducted. The software SoundPlan 7.1 was used for the modelling and the noise level calculated in accordance with the Nordic Prediction Method from 1996. The model takes into account the contours of the landscape, the main buildings at the factory site and the main noise sources on the site and the nearest surroundings. The main noise sources found at the factory site are following:

- Fans
- Wood chipper
- Deep Bunker
- Crusher
- Silostation
- Sieve
- Transformer and cooling fans on the roof of the cooling tower.

The impact of other noise sources is considered negligible. Two noise maps were conducted for the factory site and the vicinity can be found in Annex. The map show a colour scale indicating the noise propagation from the plant in 2 m height above ground. Reflections from the buildings are taken into account. The impact of the noise emission from the plant at the nearest residential area are compared with the criteria of the Icelandic regulation on noise but also the criteria for the boundary of the site is examined and compared to limits in the noise regulation nr. 724/2008. The maps shows the A-weighted equivalent noise level of the site calculated over 12 hours, daytime 07-19 and night-time 19-07. The calculations assume that cooling towers and dedusting for the production is in full operation 24 hours, every day. Other operations, crushing and packing of products and dedusting of air is in operation 8 hours on weekdays.

The activity on the harbour related to the PCC Silicon Metal plant will be located at B□kugar□ur. The activities at the harbour will be irregular but it is planned that no activities will take place during the night time or on Sundays. It is assumed that the shipping scenario on a monthly basis will be 6 ships, whereas three of these six ships will be used for both import and export. The three others will only be used for import. On a yearly basis there will be seventy two ships related to the PCC Silicon Metal plant coming into the H□sav□k harbour. Thirty six of them are only importing cargo and therefore there is no loading related to them. The other half will both be loading and unloading.

The main noise sources related to the activities at the PCC Silicon Metal plant at the harbour are following:

- Loading and unloading
- Cranes
- Machines
- Transport between the factory site and harbour
- Motors of ships

6.2.3 Baseline

Presently there is no activity at B□kugar□ur and there is no industry at the proposed factory site. The area proposed for the factory site is planned as an industrial area in accordance to the municipal plan. Whereas there is no industry at this planned industry area there is no traffic between the port and the industrial area.

6.2.4 Characteristics and weight of impact

The noise emission from the PCC Silicon Metal plant has impact in two locations, at the factory site and by the harbour.

6.2.4.1 Factory site and surroundings

The main noise sources on the factory site are: fans, wood chipper, crusher and cooling fans.

A wood chipper has a noise level of 100 dB(A) in 1 m distance and is located inside to minimi□e the noise emission.

A crusher has a noise level of 105 dB(A) and is also located inside to minimi□e the noise emission.

The fans on the secondary dedusting have a noise level of 95-100 dB(A). They will be insulated such that they will not emit more than 85 dB(A). It is not clear on which side of the building the fans are located or in which height. The noise mapping is therefore conducted such that the fans are located on all sides and spread all over the fa□ade. More detailed location of those sources can lead to reduction of the noise.

The furnace and transformer on the top of the cooling water plant have a noise level around 80 dB(A).

The criteria from the Icelandic regulations states that the equivalent noise level during the day-, evening- and night-time period on the boundaries of the site shall not exceed 70 dB(A).

In Figure 23 the distribution of the noise for the daytime of the factory site can be seen. The map shows the A-weighted noise level equivalent over 12 hours and it is assumed that the activity of the site is driven on maximum effort 8 hours over the 12 hours that defines the daytime, 07-19. The operation time for the secondary dedusting fans and crushers is 8 hours during the daytime. Other noise sources are driven at the same effort 24 hours per day.

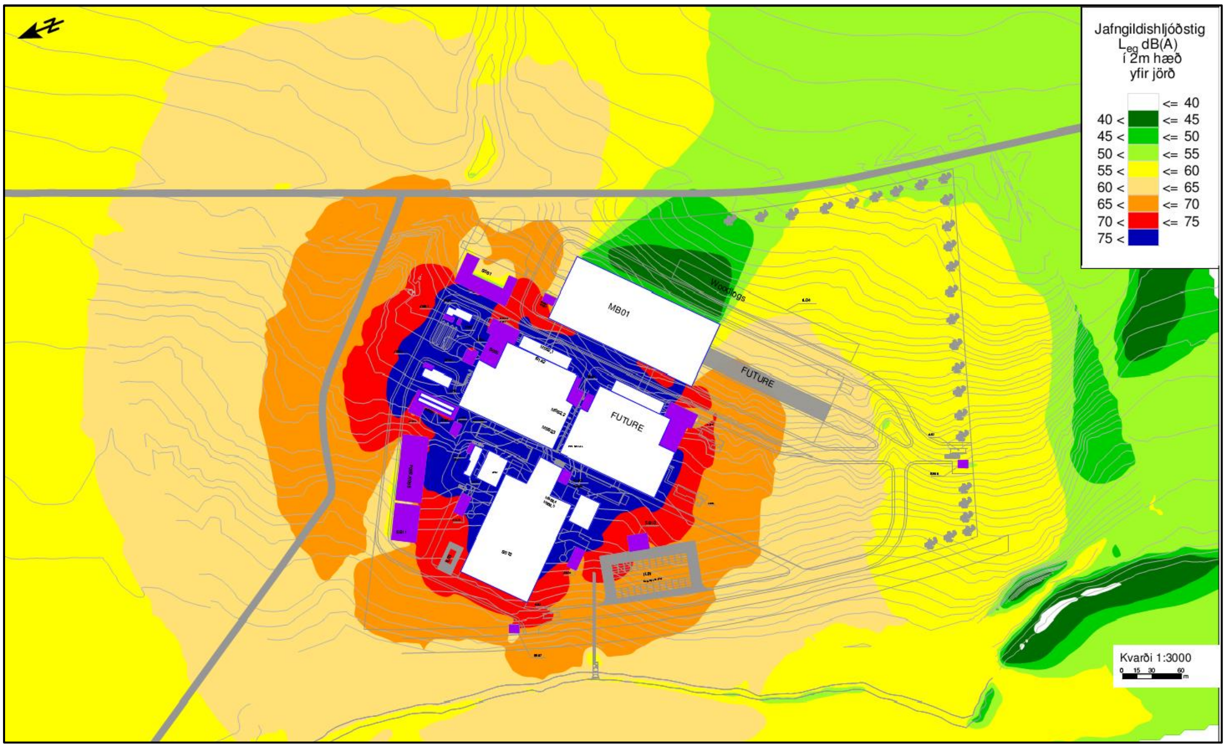


Figure 23: *The noise map for the factory at daytime, 07-19. The main noise sources during the day are equipment (fans) on top of the cooling tower, the secondary dedusting fans, the chipmaker and crushers.*

Figure 23 and 24 show that the criteria of 70 dB(A) at the boundary of the site is not fulfilled for the daytime nor the night-time period whereas the secondary dedusting fans and equipment (fans) on the top of the cooling tower are located near the boundaries. As stated before this is the worst possible case scenario where it is assumed that the fans are located on every side of the building, covering every fa□ade. Therefore it can be predicted that the noise level will be somewhat lower on the boundaries but it is unlikely that it will fulfil the criteria.

The nearest residential area is H□□insh□f□i I and II. Figure 25 and Figure 26 show the noise emission from the factory site reaching H□□insh□f□i I and II at day- and night-time.

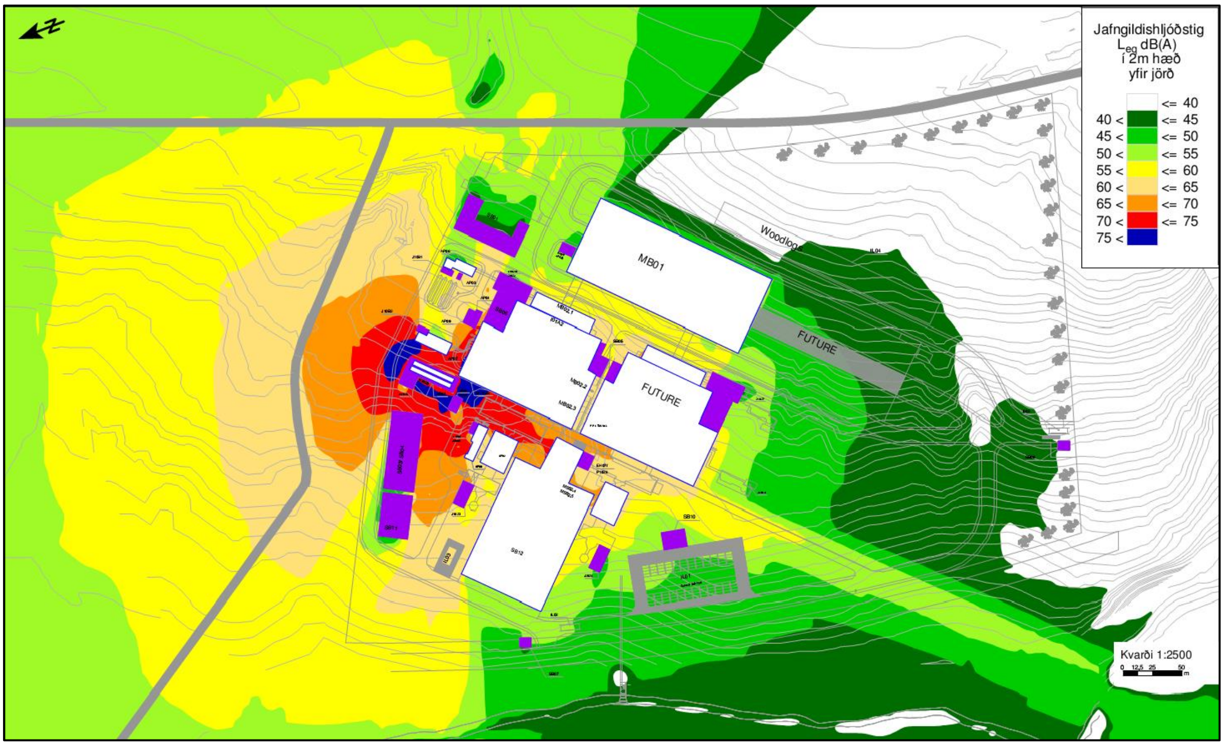


Figure 24: *The noise map for the factory at night time, 19-07. The main noise sources at night are the equipment (fans) on top of the cooling system.*

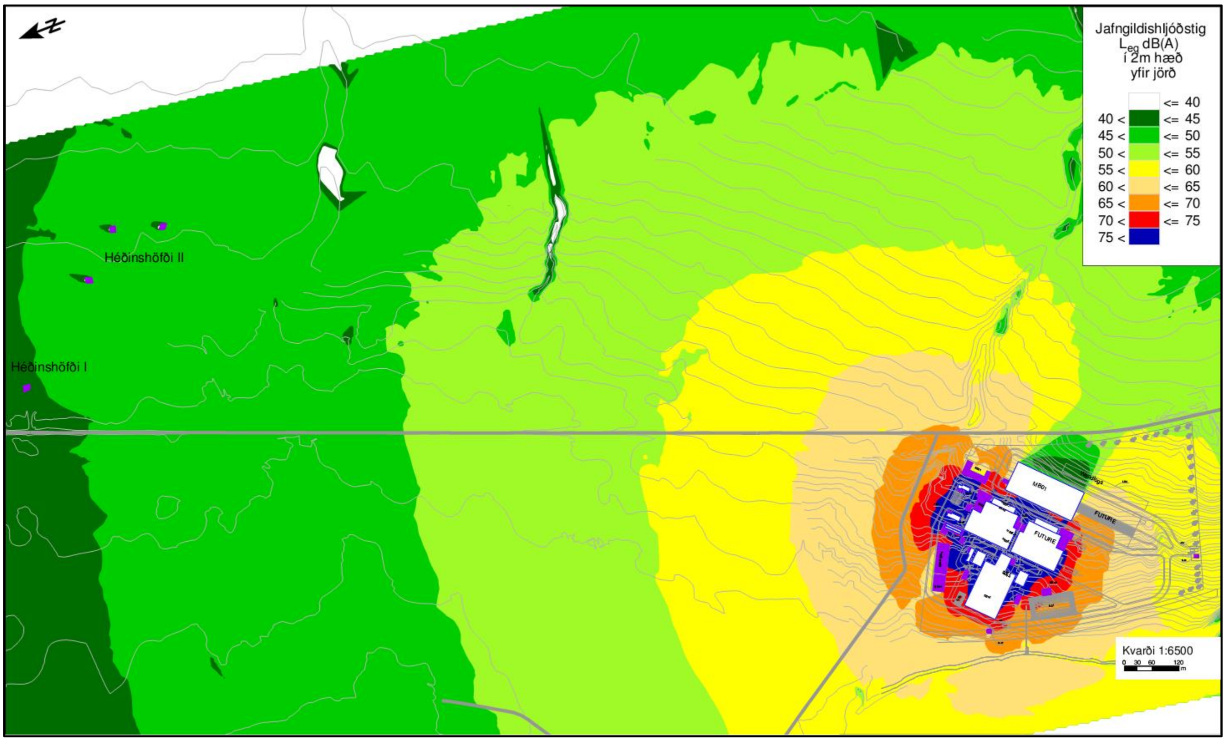


Figure 25: *The noise map shows how the noise distribution from the factory site reaches the residential area with Héðinshöfði I and II at daytime. The criteria for the daytime ≤ 50 dB(A) are fulfilled.*

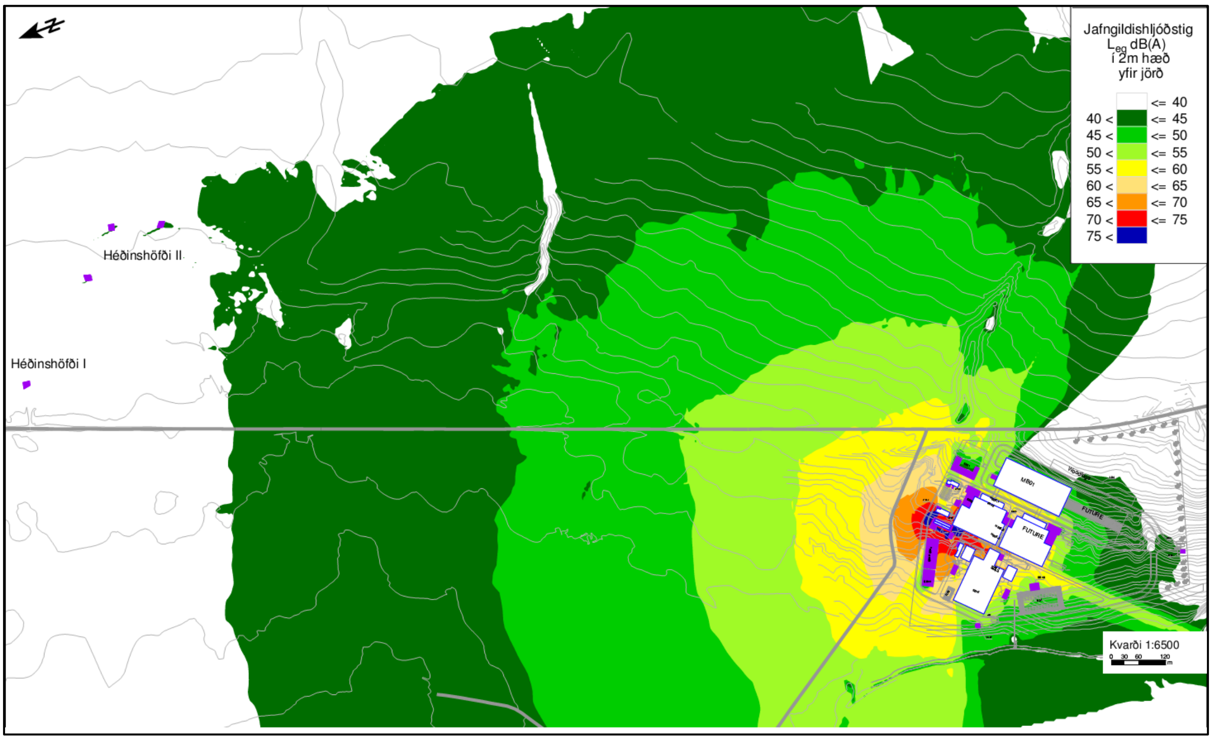


Figure 26: *The noise map shows how the noise distribution from the factory site reaches the residential area with Héðinshöfði I and II at night time. The criteria for the night time ≤ 40 dB(A) is fulfilled*.

The criteria for residential areas affected by noise from industry are divided into periods of time, day, evening, night. It can be seen that the noise level at H□□insh□f□i I and II for all the periods of the day will fulfil the Icelandic regulations with the given premises. Figure shows that the noise levels at the houses nearest the factory are in the ≤ 40 dB(A) □one but some green area can be seen in front of them. A calculation of a single point receiver at these sides of the houses showed that they are all ≤ 40 dB(A) and range from 37-40 dB(A).

6.2.4.2 The harbour and nearest surroundings

It is planned that there will be no activities at the harbour regarding the PCC Silicon Metal plant at night-time. Cranes and other machines will emit considerable noise.

A reach-stacker for container handling has a sound power level for an operational cycle 114.5 dB (A). In 10 m distance from the machine the sound power will be approximately 85 dB(A). Hydraulic grab crane for discharging resources has a sound power level for an operational cycle 105 dB(A). It is planned to use a grab crane with an electric motor, in order to reduce noise emissions. Noise level from ship motors will also influence the noise emission from the harbour. The most dominant noise source will be the loading and discharging of containers where empty containers create more noise than the loaded ones. This is a single noise event and not a steady noise. Single noise events are more disturbing than steady ones. It is difficult to estimate the noise level from these events but with experienced crane drivers the noise level will be minimi□ed.

Whereas the criteria is for an equivalent noise level and because of the distance from B□kugar□ur to the nearest residential area, it is assumed that the nearest residential area will not be exposed to noise levels higher than given criteria in the Icelandic regulations.

In an evaluation report made for the Alcoa aluminium smelter in September 2010 a noise map was conducted for the premises at the harbour, see Figure 27.

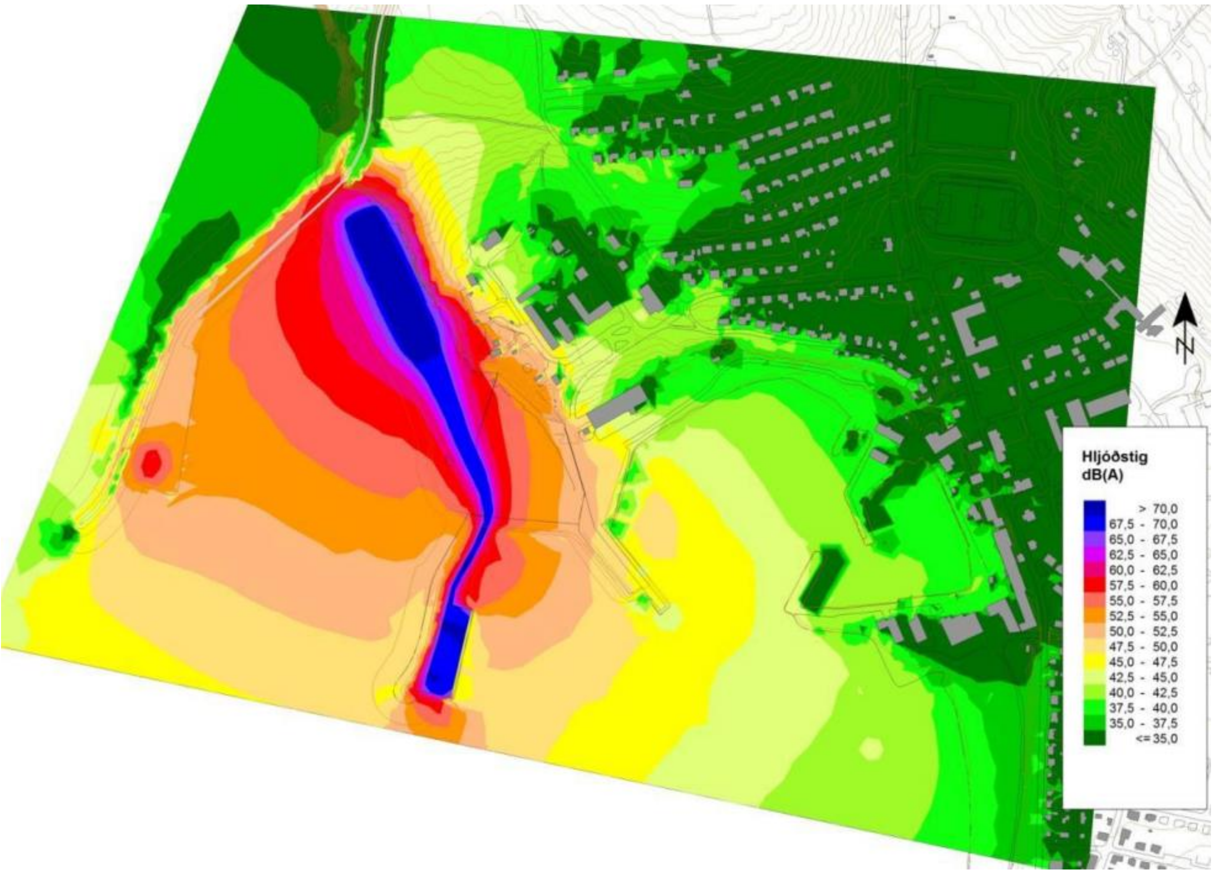


Figure 27: *A noise map for the proposed premises of Alcoa aluminium smelter at the Húsavík harbour. (Source: Alcoa Environmental Statement from September 2010). The map was conducted by HRV engineering in 2009*.

For the Alcoa premises it was planned that activity would take place during both day and night at the time when the ships are at the harbour. The noise sources for the proposed premises for Alcoa are comparable to the noise sources on the harbour premises for the PCC Silicon Metal plant. The difference lies in the rate of ships and night activities. By looking at **Error! Reference source not found.**27 it can be seen that the nearest residential area is not exposed to more noise than the Icelandic regulations require. The distance from B□kugar□ur to the residential area is greater than from the proposed harbour premises for Alcoa and therefore indicates that the noise level from the PCC harbour premises will fulfil the Icelandic regulation criteria.

6.2.4.3 Transport between the harbour and factory site

It is assumed that there will not be a lot of storage at the harbour itself but rather that transport from the harbour to the site will take place promptly. This leads to increase in traffic those days that the ships are at the harbour. It is planned to construct a road along the coastline from the harbour to the factory site where most of the road will be in a tunnel. All transportation regarding the PCC Silicon Metal plant between the harbour and the site will be directed into this tunnel and thereby the traffic will not have impact on the traffic on the public road nor the noise emission on the nearest residential area. Trailer trains and tipping trails will mainly be used for the transportation between the harbour and the factory site. These vehicles operate at 30 km/h and it is therefore preferable to minimi□e their transportation on public roads. In the case of the tunnel being closed, for example due to external circumstances, the transportation between the harbour and the site will be directed temporarily through the public road. This will lead to increased load on the public road and increase in noise emission on the residential area. In this case regular vehicles will be used instead of the low speed vehicles. The use of the public road will be avoided as possible and will preferably only take place in emergencies.

6.2.5 Mitigation measures – monitoring

In the design and layout of the activity regarding the PCC Silicon Metal plant the noise emission will be taken into account and arrangements made such that the impact of the noise emission will be minimi□ed.

To fulfil the noise criteria at the site boundary it is advised to simply move the northern boundaries to the road. In Figure 28 the proposed boundary of the site is shown as a dark blue line. Then the noise criteria at the site boundaries would be fulfilled.

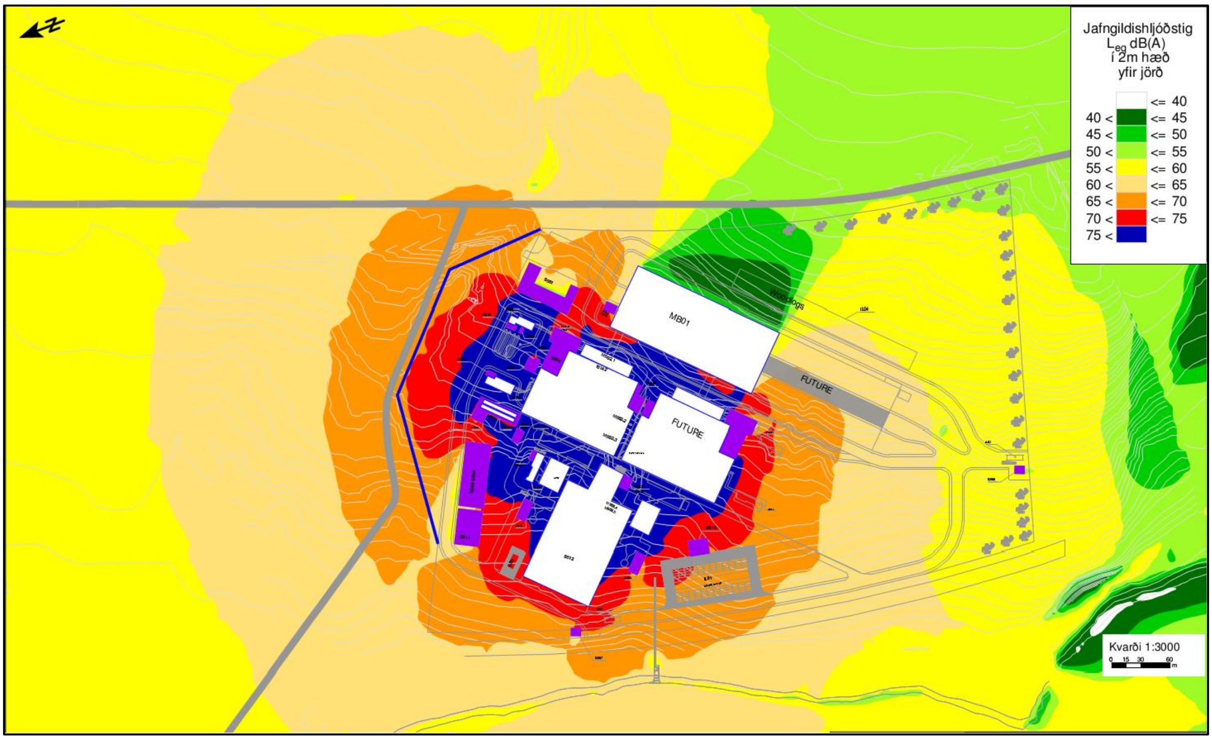


Figure 28: *The dark blue line is the proposed boundaries of the site such that the sound level at the boundaries will fulfil the Icelandic regulations.*

There is also the possibility to use noise barriers but whereas the noise sources are high up the effectiveness of the barrier is not considered enough to decrease the level significantly at the boundaries, unless the barriers is relatively high. However, it is preferable to move the crushing and its secondary dedusting from the boundary of the site to a more central location at the site if possible, whereas there is an administration building right beside the secondary dedusting which can lead to discomfort for the employees in the administration building, which leads to higher building costs due to acoustic actions. It is assumed that the employees would want to have the possibility to open windows.

It is planned to perform noise measurements when the 1st phase is ready and then again when the and 2nd phase is complete. Routine measurements will be performed in the future as a part of the monitoring program.

6.2.6 Conclusion

The impact of noise emission from the PCC Silicon Metal plant is negligible except in the nearest surroundings. That applies to the factory itself and the premises at the harbour. The impact on the nearest residential areas will be in accordance with the Icelandic regulations on noise nr. 724/2008 regarding both to traffic and activity. The requirements on the noise level on the boundary of the factory site are though not fulfilled. This is due to high noise levels from the secondary dedusting fans for the crusher and equipment on the cooling tower located very near the boundaries.

6.2.7 Review and comments on noise and PCC's answers

6.2.7.1 Comments of the Health Inspectorate of NE Iceland

The Health Inspectorate of NE Iceland (HNE) comments: „ *It is stated that the impact from noise from the operation of the silicon metal plant will be negligible except in the nearest surroundings of the plant and in the harbour area. At those locations it is considered that the noise criteria cannot be met without mitigation measures. The HNE believes it is natural to set strict requirements to mitigation measures with the purpose of the requirements of the noise regulation to be met."*

Answer PCC: It is stated in the IEIS that the noise criteria will not be met on the northern boundaries without implementation of mitigation measures on the lot boundaries. The possible mitigation measures are described in the document, but they are, use of sound barriers, transfer of secondary dedusting away from the boundary and also transfer the lot boundaries to the north. In this context it should be mentioned that the area north of the northern lot boundary where the noise can be above the limits is an area where no construction is planned. Those who are subject to the impact are those walking along the road or the river.

6.2.7.2 Comments of the Environment Agency of Iceland

The Environment Agency of Iceland comments: *„It is assumed that the noise level in residential areas in the immediate vicinity of the plant will be within the limits of regulation 724/2008 on noise. On the lot boundaries however, it is assumed that the requirements of the regulation can only be met if mitigations measures for further noise reduction are implemented. The Environment Agency wishes to raise the question whether those measures are actual mitigation measures, since those measures would be undertaken so the noise on the lot boundary will be in accordance with the above mentioned regulation."*

Answer PCC: In the opinion of the developer this is one of several possible options regarding mitigations measures to comply with the noise regulations and to reduce disturbance from the plant to the area north of the site boundary.

6.2.7.3 Comments from inhabitants and landowners of Héðinshöfði

Residents and landowners at H□□insh□f□i comment: *„Are there any plans to reduce negative impact, such as […] such as impact of noise on the residents of Héðinshöfði?"*

Answer PCC: Results of noise calculations show that requirements on the noise level will be fulfilled at H□□insh□f□i farm and therefore no mitigation measures for noise are needed there.

6.3 Flora

6.3.1 Assessment criteria

The assessment of the impact on flora is based on the following criteria and policy documents:

- The Icelandic Institute of Natural History Red List on indigenous species in threat of extinction (plants)
- List of 31 protected plants according to notice nr. 184/1978
- Rare plants and national value
- Definitions and types of habitats

□The protective character done for highland, however assumed to apply for lowlands

The Bern Convention (on the Conservation of European Wildlife and Natural Habitats) came into force in 1982 and was introduced in Iceland in 1993. The convention sets out to conserve European wild flora and fauna species and their habitats, especially the species that need to be protected internationally. There are four appendices and the first three set out particular flora and fauna species that need to be protected as well as the appropriate requirements on their protection.

6.3.2 Documents and studies

The assessment of the impact on flora is based on the results of fieldwork and assessment carried out by biologist □lafur Einarsson. The specialist report on vegetation and birdlife can be found in Annex 4. A field research on the area was done on September 4th 2011. Field research in the autumn are well suited for observation on vegetation, but early-season high plants (vascular plants) are generally not prominent during that period. Vegetation within the area was described, species recorded and photographs taken of vegetation and land on site. The ground cover and the composition of plant species was investigated in 5 areas in order to obtain a more detailed picture of the vegetation than a plants index would provide. During investigation, cover frames of 50 x 50 cm were used. Plant species were identified and the coverage evaluated visually and presented in percentages. The total cover can thus be higher than 100□, given that the cover of one species is e.g. 50□ and another 95□. A few mosses, lichens and fungi species were identified, but no focus was on collection or analysis of those organisms.

Furthermore, sources on natural conditions at Bakki were investigated. Extensive research has been conducted in this area and its surroundings in relation to a proposed aluminium smelter project.

6.3.3 Baseline

In total, 108 species of high plants were found in the research area. Most of them were dry land plant, as little wetland is in within the research area. Three moss species, six lichens species and two fungi species were recorded in the area, but there was not a strong emphasis on recording low plants (non-vascular plants) and fungi. Some scattering plants and garden plants such as red champion, large yellow loosestrife and willows exist within the area since garden waste and soil has been disposed of on various locations within the site.

There are a few vegetation groups in the suggested project site. Heathland is prominent. Heather is very dynamic and diverse vegetation found in the heathland. The highest number of species was identified and recorded in the heathland. Erosion was affecting parts of the land, mainly due to overgra□ing in the area. Erosion spots were visible and appear clearly on aerial photographs. In most areas west of the road passing through the area and also in the northernmost part, near River Bakka□, grasses were more prevalent than heath. A wetland spot is located at River Bakka□. The wetland is partly an old field, still wet despite drainage. Furthermore, streams and brook channels were found within the area with diverse vegetation by the embankments. A slight depression in the south part of the area provides conditions for more diverse vegetation, e.g. bog blueberry, bilberry (a□albl□ber), matgrass and several other plants. In the southern part a significant number of birch plants have been planted.

Figure 29: *Heathland (dwarf shrub heath) at Bakki, September 4th 2011. Heather and crowberry are dominating. (Ólafur Einarsson, 2012).*

Figure 30: *Wetland spot at River Bakkaá, partly an old field, wet despite drainage, September 4th 2011. (Ólafur Einarsson, 2012).*

In stony gravelly cambric vitrisol cover (melur), vegetation was poor and only a few species recorded. Alaska lupine was spreading over the stony gravelly cover and was the dominant species in some spots in the southern part between the highway and the road passing the research area. Examples of areas where lupine grows are shown in **Figure 32** and in ***Figure 33***.

Figure 31: *Diverse vegetation at Bakki September 4th 2011. (Ólafur Einarsson, 2012).*

Figure 32: *Birch plants planted close to Skjólbrekka on September 4th 2011. Cambric vitrisol (Icelandic: melur) with lupine in the back (Ólafur Einarsson, 2012).*

Figure 33: *Alaskan lupine close to Bakki September 4th 2011. (Ólafur Einarsson, 2012).*

Information on many different species has been registered using a reference grid that was initially thought for the registration of plants. The system is made out of 10x10 km grid which has been used in Iceland for decades to register the expansion of species. Now work has begun on the registration of plants in a more detail, in 5x5 km grid, but this work is not completed and the information not available as is for information from the 10x10 grid which is available on the Pl□ntuvefsj□ [e. Plant Webview] of the Icelandic Institute of Natural History

According to the 10 x 10 km reference grids the research area is in squares no. 5737 and 5738 and the flora is considered to be well known according to information in Pl□ntuvefsj□ of the Icelandic Institute of Natural History (IINH). Most of the area is in square 5738. According to the Plant Webview a total of 242 high plant species and ferns, 125 moss species, 80 lichens species and 25 species of fungi are recorded within this square. In square 5737, a total of 199 species of high plants and ferns, 165 species of moss, 110 species of lichens and 9 species of fungi were recorded. In the research area only a part of the plants recorded in these squares could actually be found.

In a research conducted by the East Iceland Environmental Research Institute (EIERI) (N□tt□rustofa Austurlands) on the suggested industrial site north of the River Bakka□, a total of 117 species of high plants were found, which is similar to the number of plants found south of the river (108 species). The number of wetland plants south of the river is lower since the wetland area is considerably smaller than north of the river.

Plant species on the red list of plants considered to be in threat of extinction were neither found in the research area nor in the research conducted by the EIERI north of River Bakka□. A study conducted by the Icelandic Institute of Natural History on nature in H□□insv□k bay and surroundings is consistent with the above findings, no high plants listed on the red list or plants considered to be rare nationwide could be found. Of the 238 recorded species of high plants, 219 are considered to be wild and the other 19 to be scattering plants. A total of 177 species of fungi were found in the study, none of them on the red list but one of them is considered rare nationwide; the Dotted Thyme-moss (*Rhizomnium punctatum)* and two are considered to be rare; Didymodon Moss (*Didymodon brachyphyllus) and* Spiral Extinguisher-moss (*Encalypta streptocarpa).* A total of 123 species of lichens were recorded, none of them on the red list, but one of them, Aquatic aspicilia (*Aspicilia aquatica),* is considered rare nationwide. Furthermore, three species of fungi were found that are similar to lichens and are rare nationwide. According to the red list, the lichen species Monk's-hood lichen (*Hypogymnia physodes)* and Tube lichen (*Hypogymnia tubulos)* have been found in the area, species that are considered to be somewhat threatened (LR). Both of these lichen species grow on birch and in histosol soil (*icel. móajarðvegur*) and are mainly found in the Eastern part of Iceland. The lichens were found on fence posts in the mid-20th century and it is not certain if can be found there. A great deal of fences has been removed as a result of less farming in the area; it is therefore unlikely that these lichens still grow in the area.

The IINH has in the last years recorded habitats in Iceland. This work has mainly been confined to the highlands but work on lowlands started in 2012 but no results have been published yet. Habitats on lowlands have not yet been classified. Heathland was prominent in the research area and has for a long time characteri□ed the area. Heath land is common across the country, especially in the □ingeyjars□slur counties as can clearly be seen in the area. According to the EUNIS habitat classification, heath land would classify as *Subarctic and alpine dwarf willow scrub* (F2.1). The heathland in the research area was flusher and had a higher coverage than highland heath lands. The conservation value of heath land in the highland is considered high, so it can be reasoned that the same applies for heathland in the lowlands.

In the area south of River Bakka□ there are a few wetland spots, less than 3 ha, as opposed to the area north of River Bakka□, where the construction of an aluminium smelter was planned, but it has been assumed that the si□e of the wetlands in that area covers around 36 ha.

Vegetation in sea- and bird cliffs haven been little studied in Iceland because of how difficult it is to get to these places. The effect of the proposed construction will probably be low on vegetation in the sea cliffs, expect for a potential impact if the option with the sea cooling will be chosen, see chapter 7.1.

6.3.4 Characteristics of impacts

The impact on vegetation is mainly due to the loss of vegetation that goes under structures, i.e. factory buildings, roads and car parks. The si□e of the site for the PCC SE Silicon Metal plant is around 20 ha. The total surface of the plant is 160,000 m^2 and parking around 800 m^2. It is very difficult to reclaim heathland or to develop it from scratch, therefore it cannot be considered as a mitigation measure. It would be desirable to disrupt the heathland and the wetland spots close to River Bakka□ as little as possible. It is possible to reduce the environmental impact by locating the plant on wind eroded stony cambric vitrisol (melur) in the middle of the area, where the vegetation is more restricted.

In the scoping document for the project it is stated that it is planned to change the riverbed of River Bakka□ and creeks in the area as a part of constructions by the Nor□ur□ing municipality. In a study conducted on the biota of Rivers Bakka□ and Rey□ar□, the impact of the operation of an aluminium smelter on the habitat of the rivers was assessed. The authors believe that there are three kinds of impact on the rivers, i) impact due to changes in the riverbed and flow, ii) impact on the biota due do discharges from the site, iii) negative impact from chemicals in airborne emissions. These chemicals could mix into soil and surface waters and cause changes in the aquatic ecosystem in the vicinity of the plant. It is expected that the same impacts apply for this project.
The proposed Silicon Metal plant and planned construction is considered to have a considerable negative impact on vegetation and wetland on land where vegetation disappears and the impact is reversible on land that goes under structures.

6.3.5 Mitigation and monitoring

In the opinion of the specialist, a few ways are possible to compensate for the disruption caused by the construction of the silicon metal plant and these are discussed in general. It is for example discussed to what extent reclamation in other areas should be considered given that most original vegetation is removed from the area. It is however noted that this is not common practice for other types than wetlands. Given that the vegetation within site is common and does not have specific conservation value, this is not considered necessary.

It is recommended as a mitigation measure that PCC reclaims wetlands to the same extent as disturbed. A relatively small area of wetland is disturbed within the site and no wetland above 3 ha exists within the site. During design, the disturbance of wetlands will be avoided as possible and no changes are planned to the River Bakka□ or because of the construction

It is also recommended that local plants, especially heath vegetation growing in the area are used to reclaim green areas within the site. Furthermore heathland could be removed before disruption of the area, and put on eroded areas on site.

6.3.6 Conclusion

The proposed silicon metal plant is considered to have a considerable negative impact on vegetation and, since vegetation cover will be disrupted and the changes are irreversible. Possible mitigation measures include land reclamation, using Icelandic plants or i.e. Alaskan lupine, common in the area. The vegetation within the area is common and is not a subject of protection. When considering the criteria above and the characteristics of the impact it is assumed that the impact of the construction on vegetation and wetland is ***considerably negative.***

6.3.7 Review and comments on Flora and PCC‘s answers

The Environment Agency of Iceland comments: *„There are a few vegetation groups in the suggested project site and heathland is prominent. Grassland is also prominent. Diversity of species is quite high, but plants are neither considered to be on the red list of plants considered to be in threat of extinction or plants considered to be rare nationwide. The IEIS*

discusses possible mitigation measures that can be implemented due to disturbance of vegetation. It is pointed out that the recovery of some of the vegetation groups present on the construction site can be difficult. Wetlands have for several years been recovered with good success. The Environment Agency therefore suggests recovery of wetlands as implementation of mitigation measures, regardless of any disturbance of wetlands or not."
Answer PCC: The impact of the plant on vegetation is not considered to be of an extent that requires the implementation of special mitigation measures. Therefore it is not considered necessary to make the recovery of wetlands or land reclamation an obligational mitigation measure for the disturbance of land within an industrial area, which has partly already been disturbed or is covered with lupine and common and widespread plants. The same would not apply for disruption of wetlands or rare vegetation groups.

6.4 Birds

6.4.1 Assessment criteria

The assessment of the impact on birdlife is based on the following criteria and policy documents:

- List of species in threat of extinction and rare species
- Responsibility species
- Important species nationwide
- Species covered by international agreements
- A total of 32 bird species are on the list of species in threat of extinction. Those include small populations, new settlers and birds that are on the border of their distribution in the area. Although relatively few bird species breed in Iceland the number of individuals is often very high and therefore often a high proportion of the European or world population.
- In international cooperation these species are called *responsibility species*.

If referring to a 30 minimum of the European population, there are at least 16 bird species that breed here that Iceland carries a great responsibility for. Some of the species stop in Iceland on their way from their more northern nesting grounds but do not lay eggs in Iceland. They are called migrant birds. Iceland is an important resting place for those birds and Iceland carries a great responsibility for migrant species.

- All European bird species have been classified *by BirdLife International* in relation to their protection status within the region. The species are divided into four groups, so called SPEC groups *(Species of European Conservation Concern)* or European bird species that need protection.
- SPEC 1: Species of global conservation concern.
- SPEC 2: Concentrated in Europe, unfavourable conservation status.
- SPEC 3: Not concentrated in Europe, unfavourable conservation status.
- SPEC 4: Concentrated in Europe, favourable conservation status.

Other species not belonging to these groups are either in no danger or have major coverage in Europe.

The Bern Convention (on the Conservation of European Wildlife and Natural Habitats) came into force in 1982 and was introduced in Iceland in 1993. The convention sets out to conserve European wild flora and fauna species and their habitats, especially the species that need to be protected internationally. There are four appendices and the first three set out particular flora and fauna species that need to be protected as well as the appropriate requirements on their protection.

6.4.2 Documents and studies

The assessment of the impact on birdlife is based on results of observations and the assessment of biologist □lafur Einarsson (□lafur Einarsson, 2012). The specialist report on vegetation and birdlife can be found in Annex 2. A field research on the area was done on September 4th 2011. Most laying birds had then left, but since information on the area and its surroundings were available, including studies carried out for the environmental impact assessment of a proposed aluminium smelter in the industrial area at Bakki, it was assumed unnecessary to perform more extensive research on birds.

All birds seen or heard during the observation were registered. When fog reduced visibility during observation, birds were identified by their noise.

6.4.3 Baseline

During the field work on September 4th, 2011, 19 bird species were found on and around the investigation site. Only parts of the species were seen using the site as their habitat. The birds that use it as habitat are mostly grassland birds (*icel. mófuglar*) such as the European Golden Plover (*icel. heiðlóa*) and Ptarmigan (*icel. rjúpa*) that were seen with fully fledged young that possibly hatched at Bakki. Redwing (*icel. skógarþröstur*) was seen looking for food and a Meadow pipit (*icel. þúfutittlingur*) could be heard. A Merlin (icel. smyrill) flew over looking for pray, probably one of the grassland birds. Thirteen of the bird species that were seen could possibly breed in the research area.

As was described above, no further research on birds were conducted.

The observation in September 2011 only gave information to a little extent on which birds might lay eggs south of River Bakka□. The East Iceland Environmental Research Institute (EIER) performed a study on bird life in the area north of River Bakka□ where the construction of an aluminium smelter was proposed. In this study 24 species were found, 20 of which were layers (breeders) in the area north of River Bakka□. Most of the species registered north of River Bakka□ probably also lay their eggs in the area south of the river, where 17 species are believed to be layers. Unlikely layers in the southern part of the area include Pewit (*icel. hettumáfur*), Godwit (*icel. jaðrakan*) and Red-necked Phalarope (*icel. óðinshani*), because the wetland south of the River Bakka□ is smaller than the wetland north of the river.

EIER counted grassland (or heathland) birds in the summer of 2007 and found that the highest breeding density of birds is at Bakki, or 319 couples per km^2 in heathland and 301 couples per km^2 in wetland. This is one of the highest densities of grassland birds found in Iceland. Since heath land covers the majority of the research area south of River Bakka□ it can be assumed that the breeder density is high, compared to the above study. The density of grassland birds is probably similar north and south of the river.

The following summary of likely layers in the research area is based on information taken from a report of EIER, combined with an estimation of the number of layers/breeders based on the circumstances at the research area south of River Bakka□. A summary of these birds is presented below.

Fulmar is a responsibility species and it is likely that a few couples breed in the rocks by the coast. There is no mention of the number of couples that breed north of River Bakka□, but the Fulmar is said to breed there.

Graylag goose is on the list of species in threat of extinction as a vulnerable species (VU) and a responsibility species. A few couples probably breed south of River Bakka□ but the number of couples breeding north of the river is not mentioned.

Golden plover is a responsibility species and in SPEC group no. 4. Golden plover is one of the most common birds in sections north of River Bakka□ and the density in heathland was estimated to be 89 couples per km^2, which is a high number. In comparison, in the lava fields by Road □rengslavegur (nr.39) in SW-Iceland the density is 19 couples per km^2. Since grassland and heathland is dominant south of River Bakka□, a similar density as north of the river can be assumed.

Snipe found in Iceland are of the sub-species *Gallinago gallinago faroeensis.* It is one of the more common birds in the northern part and found both in wetlands and grassland. In grassland the density was assessed to be 35 couples per km^2 and a similar density can be assumed south of the river.

Artic tern is a responsibility species. North of River Bakka□ it was assumed that 70 couples were laying/breeding in total. Since the research area south of the river is smaller than the area north of the river it can be assumed that the number of terns is by far less, a few do□en at most.

Dunlin is a responsibility species and in Iceland the sub-species is *Calidris alpina schinzii*. It breeds both in grasslands and wetlands north of River Bakka□. The density in the grasslands is about 28 couples per km^2 and it is likely that the density in grasslands south of the river is similar.

Ptarmigan is an endemic sub-species, in Iceland *Lagopus mutus islandorum* breeds. North of River Bakka□ the density of ptarmigan was not estimated since the period of observation, June, was not suitable. There are probably a few female birds that lay in an area south of the river. Tj□rnes peninsula is one of the better breeding grounds for ptarmigan in Iceland, with one of the highest breeding densities, but in the area round the farm H□ll, the median density of male birds was around 14.4 birds per km^2.

Ringed plover is a responsibility species and in Iceland represented by the sub-species *Charadrius hiaticula hiaticula.* It is believed to breed north of the river, but it is not stated how many couples breed there. Since cambric vitrisol (melur) covers are prominent in the southern area a few couples of ringed plover can be expected there. It may be in retreat south of River Bakka□ with the continuing spread of Alaskan lupine in the area.

Redwing is a responsibility species, in SPEC group no. 4. The sub-species *Turdus iliacus coburni* breeds in Iceland and in the Faroe Islands. It is said to breed north of River Bakka□ but the number of couples is not stated. It most likely breeds in the most southern part of the proposed industrial area where birch plants grow. In total a few do□en couples can be expected.

Whimbrel is a responsibility species in SPEC group no. 4 It is a dry-land bird with a high density in the heathland north of River Bakka□ (55.2 couples per km^2) and a similar density can be expected south of the river.

Redshank is a responsibility species in SPEC group no. 2. In Iceland the endemic sub-species *Tringa totanus robusta* breeds. The Redshank is the most common bird that breeds in the area north of the river with an estimated high breeding density in both wetland (147.2 couples per km^2) and heathland (70.0 couples per km^2). The density of Redshank south of the river is probably similar to the density in heathland north of the river.

Harlequin duck is registered as a species that breeds north of River Bakka□, but the number of breeding couples is not stated. It can be assumed that just a few couples breed south of the river.

Great black-backed gull is on a list of species in threat of extinction as a vulnerable species (VU) and in SPEC group no. 4. It was registered as a breeding bird north of River Bakka□ but the number of breeding couples is not stated. One or two couples might breed south of the river.

Herring gull is also on a list of species in threat of extinction as a vulnerable species (VU) and in SPEC group no. 4, also registered as a breeding bird north of River Bakka□. The number of breeding couples is not stated, but one or two couples might possibly breed south of the river.

Oystercatcher is registered as a breeding species in the area north of the river, but the number of breeding couples is not stated. It is likely that a few couples breed south of river.

Meadow pipit is in SPEC group no. 4. The density was 55.2 couples per km^2 in heathland in the area north of the river, but they were not registered in the wetland. The density is significantly higher than in the lava fields by Road □rengslavegur (nr. 39) in SW-Iceland where it was 27.4 couples per km^2. South of River Bakka□ a similar density can be assumed as in the heathland north of the river.

Eiderduck in Iceland belongs to the sub-species *Somateria mollissima borealis.* North of River Bakka□ it is assumed that 20 couples are breeding. South of the river it can be assumed that only a few couples breed.

A **falcon** nest has been found close to the construction site. A direct impact on falcons is not expected, but there is the possibility of an indirect impact since the habitats of tarmigans and other grassland birds will be disrupted and the number of birds in the area will decrease, resulting in less pray for the falcon couple. Research on the Icelandic falcon has shown that it hunts for pray up to 57 km away from its nest. Bakki is within the hunting area of the falcon couple. The falcon is on a list of species in threat of extinction as a vulnerable species (VU). The Icelandic falcon population contains only a few breeding couples, or between 300 and 400.

Considerable birdlife is on the coastline of Bakki during wintertime. The northern end of the bird count area, *Húsavík: Norðurgarður - Reyðará á Tjörnesi,* extends into the research area. During the winter count of bird viewers and the Icelandic Institute of Natural History on January 7th 2012, 17 species or 2416 individuals, including 27 harlequin ducks *(icel. straumönd)*. The Tj□rnes peninsula is an important winter habitat for harlequin ducks and is of international value for the species. Harlequin Duck is on a list of species in threat of extinction of some risk (LR) and classified as a responsibility species. No mammals were observed in the area during the observation area. No fox or fox hollows were seen in the research area or close to it and no remains of fox were found. It can be assumed that mink moves along the coastline and rivers and creeks within the area. Field mice probably live where habitats are available.

6.4.4 Characteristics of impacts

The birds that are subject to impact cause of the construction are common, both nationally and within the region (NW-Iceland). Since the area of the impact is relatively small, the construction is not believed to have an impact on the population si□e of species that breed/lay on the construction area or use the site in any other way. The proposed project is therefore assumed to have a negligible impact on birds.

According to observations many birds, mainly knots, visit the shore at Bakki. In the spring of 2008 a total of 7000 birds were assumed to have visited the shore. The area from Laugardalur valley to Bakkakr□kur was the area least visited by birds. Of the whole area at Bakki, Bakkakr□kur was one of the important sites for birds. **Table 15** lists species likely to be found in the research area that are on the list of species in threat of extinction or responsibility species. Furthermore it shows the SPEC classification and entries in the Annex to the Bern Convention.

Table 15: *Likely laying/breeding birds in the research area and their classification into species in threat of extinction and responsibility species.*

Species	Latin name	In threat of extinction	Responsibility species	SPEC classification	Bern Annex
Fulmar	Fulmarus glacialis		x		III
Graylag goose	Anser anser	VU	x		III
Golden plover	Pluvialis apricaria		x	4	III
Snipe	Gallinago gallinago				III
Artic tern	Sterna paradisaea		x		III
Dunlin	Calidris alpina		x		III
Ptarmigan	Lagopus muta				III

Ringed plover	Charadrius hiaticula		x		III
Redwing	Turdus iliacus		x	4	III
Whimbrel	Numenius phaeopus		x	4	III
Redshank	Tringa totanus		x	2	III
Harliquin duck	Anas platyrhynchos				III
Great black-backed gull	Larus marinus	VU		4	
Herring gull	Larus argentatus				
Oystercatcher	Haematopus ostralegus				III
Meadow pipit	Anthus pratensis			4	II
Eiderduck	Somateria mollissima		x		III

6.4.5 Mitigation and monitoring

No mitigation measures are suggested for birds.

6.4.6 Conclusion

Considering the criteria mentioned above and the characteristics of the impact it is the conclusion that the impact of the project on birdlife is ***negligible***. A considerable negative impact might occur due to disturbance during construction of the possible seawater intake, if carried out in spring, when the birds frequent the Bakkakr□kur coast, see Chapter 7.1.

6.5 Landscape and visual impacts

6.5.1 Assessment criteria

In the NPA's guidelines for the assessment of the impact of individual environmental aspects the discussion of landscape is divided into two categories, the criteria for the natural landscape and the cultural landscape.

The assessment of the impact is divided into two parts. On one hand the direct influence on scenery as a result of land forming. On the other hand the visual impact of the land forming on the adjacent area.

The assessment of the direct impact on scenery focuses on two main aspects:

- Uniqueness/rarity of landscape
- Main characteristics of landscape, i.e. untouched/natural appearance, form, richness of colour, diversity and integrity of landscape.

The rarity of landscape can be assessed in different ways, i.e. certain types of landscape have high value on a national scale due to its scarceness in the nature or the culture, or if it is somehow symbolic. Certain types of landscapes can also be common country-wide but have value on a local level. Indications of rarity or specialties of landscape on a national level can be found in:

- Nature Conservation Register contains the areas that have been preserved or landscapes that are considered important "to preserve due to special scenery or fauna" (Article 53 of Law no. 44/1999 on nature preservation). It also states areas that stand to reason to preserve but have not yet been registered.
- Article 37 of the law no. 44/1999 on nature preservation, regarding the protection status of certain geological formations and ecosystems.
- Criteria defined in the government's policy for sustainable development, where geological formations and ecosystems that the government considers to have conservation value are listed (Ministry for the Environment, 2002)

- Local conservation in the urban development plan of the relevant municipality where areas are listed that are deemed important to preserve, i.e. due to nature, historical value or have outdoor recreational possibilities.

While assessing the impact on the *main characteristics of scenery,* aspects regarding the specialties of the area at the present time is considered, what the main scenery characteristics are and in which way the project will alter these characteristics. The assessment of the scenery shall take into account if the landscape is manmade or natural, its condition and the overall appearance of the area. Prior disruption or land use justifies in no way further disruption or construction. However, prior disruption does affect the value of the area and consequently the possible effects of new or on-going construction.

While assessing the visual aspects the focus is placed on analysing the appearance of landscape after construction from the places that would be most affected. Those places are from roads, where human traffic is most common, and from the farms on H□□insh□f□i, which are the residencies where the plant will be seen from. In addition, aerial photographs are taken, from Bakkah□f□i and from G□nh□ll above the factory to ensure more perspectives of the plant.

The article 35 in Law no. 44/1999 on nature preservation states: “When designing roads, power plants and other structures measures shall be taken to ensure that they best blend into the shape of the land.” The assessment of visual aspects is guided by this. Assessing the scale of the influence, that is in which way the structure blends into the shape of the land, the considered aspects are how the structure is located on land, if it touches the skyline, in which way it compromises the view, from which locations and how many are influenced by it.

6.5.2 Documents and studies

To assess the influence of the landscape basic data was acquired on the defining aspects on the local scenery, form of land, geological formations, hydrological formation, vegetation and land use. Sources were gathered on areas with special value due to landscape, local values and the use of the area, in regards to possible effects on the resident, outdoor recreational and industrial areas. Its basis is the published data, e.g. Nature Conservation Register, government strategies on sustainable development to the year 2020 ((Ministry for the Environment, 2002). In addition, the criteria for assessment of environmental impact are considered. They are published by the Icelandic National Planning Agency (the Icelandic National Planning Agency, 2005 and the Icelandic National Planning Agency, 2005 A). To assess the visual impact of construction, trips were taken to the site in June and October of 2012 and photographs were taken on site. The photographs were taken from selected locations, where the plant will be visible in some way. Particular attention was taken to photograph areas where people reside or pass by, i.e. residencies, roads and outdoor recreational areas. In the report photographs are shown from 7 sites, numbered from 2 to 8, on Figure 34. To assess the visual impact, a three dimensional computer model of the plant is inserted into photographs, as seen in Figures 39 to 59. The pictures are published with the preface that the quality of the land model can affect the precision of model figures and that the structures are still in development and can change. The pictures give an idea of the plants look and main dimensions.

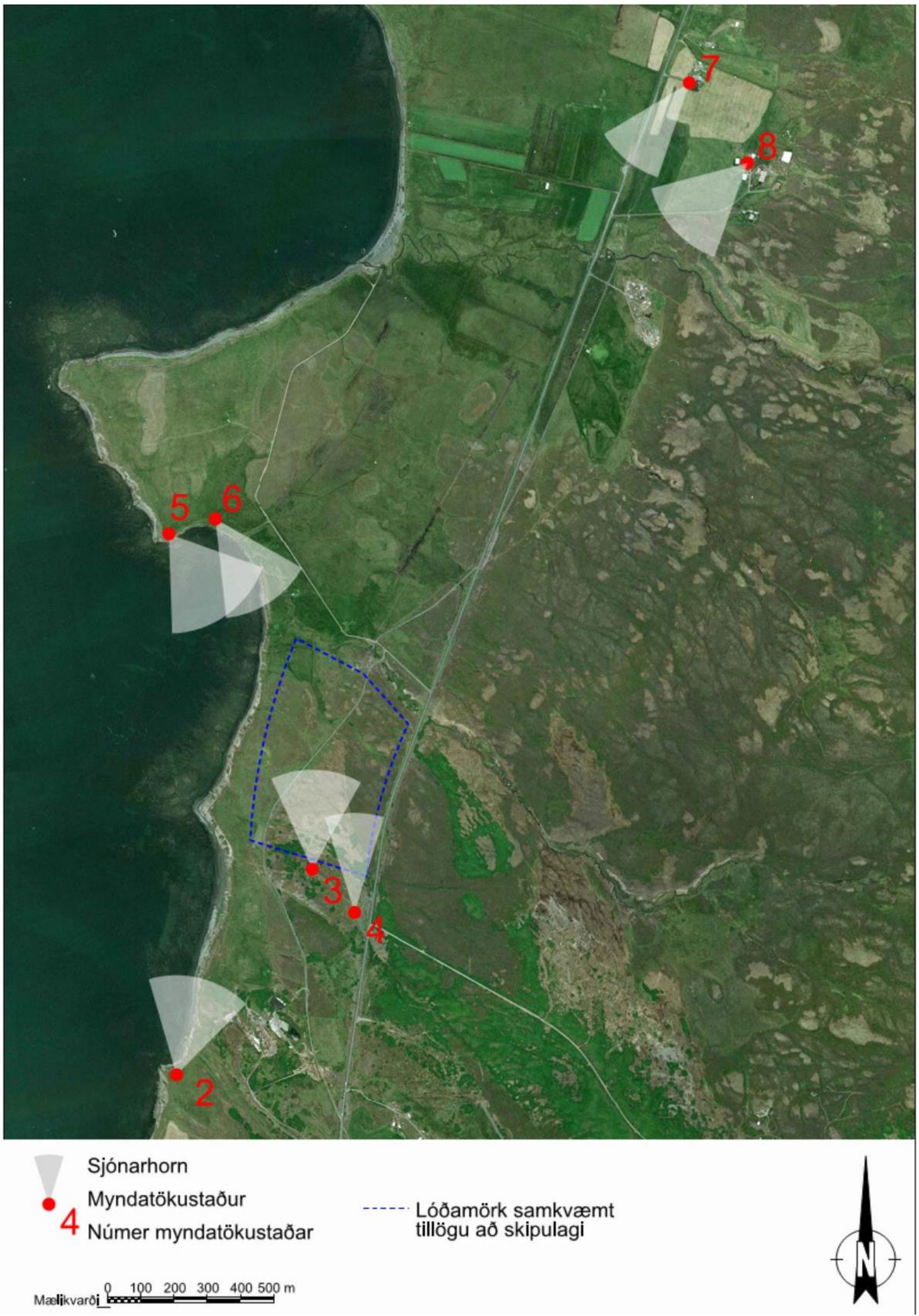


Figure 34: *The location of photo shooting sites and their perspective in regards to assessment of the impact of the PCC plant on scenery and visual aspects.*

6.5.3 Baseline

Impact area of visual impact

Figure 35: *Aerial photograph that demonstrates the model of the plant, phase 1. (Photograph Mats Wibe Lund).*

Figure 36: *Aerial photograph that demonstrates the model of the plant, phase 2. (Photograph Mats Wibe Lund).*

Direct impact on the scenery is confined to PCC’s lot on Bakki, but the premises are in total 22 ha. Photo 35 demonstrates the location of the plant according to phase 1, photo 36 according to phase 2. The plant will be visible from areas south-east of the plant, e.g. from Mt. H□sav□kurfjall. It will also be visible from areas north of the plant, e.g. from farmhouses at H□□insh□f□i and from the national road. The plant will be visible from sea and from the shore both north and south of the property until cape H□sav□kurh□f□i blocks the view from the south. The plant will not be visible from H□sav□k.

Landscape characteristics

The landscape in the area from H□sav□kurh□f□i and north to Tj□rnes for many parts resembles coastal regions. The main characteristics of the entire scenery are grass and wetlands, marine capes and rocky beaches. The plot lies in the edge of the hill between Mt. H□sav□kurfjall and beach, just south of River Bakka□. The northwest area, closest to the coast and to the River Bakka□ bed has a rather smooth terrain but the main part of the lot has an incline that requires some development before the plant is constructed. The area is vegetated and largely fenced gra□ing land. Despite the natural appearance of the area its use has left its marks on it to some extent. No geological formations are visible on the surface that put their mark on the land.

The construction area is not within the areas on the Nature Conservation Registry and has not been given any special value in regards to criteria in the laws under the Nature Conservation Act no. 44/1999. Bakkafjara and Bakkah□f□i that are in proximity of the lot but north of River Bakka□ are however on the Nature Conservation Registry.

Figure 37: *Photo taken to the north over the south part of the area that the plant will be located (Photo PCC SE)*

Figure 38: *Photo taken to the northwest over the northern part of the area that the plant will be located (Photo PCC SE)*

6.5.4 Characteristics of impact

The effects are compared with criteria, on one hand in regards to direct impact on scenery and on the other hand in regards to visual aspects and possible changes in experiences from areas around the proposed construction, with the shortcomings an evaluation of such subjective parts entails.

Effect on scenery

Uniqueness/rarity of landscape: The area has not been given any specific protection value and its scenery not considered rare on either a national or local scale, nor is it defined as wild. The effects are as such not on scenery that is considered to have a high protection value.

Untouched/natural appearance: The area is not untouched. No major structures are present and its appearance is in some level natural, though lupine, gra□ing land and erosion spots are considerably characteristic for the area.

The area will change however, it will be shaped and structures built. The effects are considerable within the limited part of the industrial site and they are considered permanent and irreversible

Visual impact

The effects of the PCC SE Silicon Metal plant on the appearance of the area are first and foremost due to buildings that will be constructed on the lot in addition to land forming

The most prominent structures will be the furnace building and the casting area which have the highest point of 37,5 m, the bag house filter and raw material storage which can be assumed to be 27 m at the highest point. The product storage and product crusher are estimated around 24 m tall. Other structures are considerably lower (see Table 3 in chapter 2.2). The structures will be most visible from the north.

The accompanying photos show a model of the plant. Photos are shown of phase 1 and 2. Assessment work takes into account both phases although the later phase has not been given a deadline. The si□e of the structures makes them prominent in their close surroundings and from adjacent areas, but in large part consists of traditional industrial, storage and office housing.

Figure 39: *View from Húsavíkurhöfði, current situation. View 2 on photo 34 (Photo PCC SE).*

Figure 40: *View from Húsavíkurhöfði, phase 1. View 2 on photo 34 (Photo PCC SE).*

Figure 41: *View from Húsavíkurhöfði, phase 2. View 2 on photo 34 (Photo PCC SE).*

Figure 42: *View from Gónhóll, current state. View 3 on photo 34 (Photo PCC SE).*


Figure 43: *View from just below Gónhóll, phase 1. View 3 on photo 34 (Photo PCC SE).*


Figure 44: *View from just below Gónhóll, phase 2. View 3 on photo 34 (Photo PCC SE).*

Figure 45: *View from Gónhóll, current situation. View 4 on photo 34 (Photo PCC SE).*

Figure 46: *View from Gónhóll, phase 1. View 4 on photo 34 (Photo PCC SE).*

Figure 47: *View from Gónhóll, phase 2. View 4 on photo 34 (Photo PCC SE).*

Figure 48: *View from Héðinshöfði, current situation. View 8 on photo 34 (Photo EFLA Consulting Engineers).*

Figure 49: View from H□□insh□f□i, phase 1. View 8 on photo 34 (Photo EFLA Consulting Engineers).

Figure 50: View from H□□insh□f□i, phase 2. View 8 on photo 34 (Photo EFLA Consulting Engineers).

Figure 51: View from H□□insh□f□i, current situation. View 7 on photo 34 (Photo EFLA Consulting Engineers).

Figure 52: View from H□□insh□f□i, phase 1. View 7 on photo 34 (Photo EFLA Consulting Engineers).

Figure 53: View from H□□insh□f□i, phase 2. View 7 on photo 34 (Photo EFLA Consulting Engineers).

Figure 54: *View from Bakkahöfði, current situation. View 5 on photo 34 (Photo PCC SE).*

Figure 55: View from Bakkah□f□i, phase 1. View 5 on photo 34 (Photo PCC SE).

Figure 56: *View from Bakkahöfði, phase 2. View 5 on photo 34 (Photo PCC SE).*

Figure 57: View from Bakkah□f□i, current situation. View 6 on photo 34 (Photo PCC SE).

Figure 58: View from Bakkah□f□i, phase 1. View 5 on photo 34 (Photo EFLA Consulting Engineers).

Figure 59: *View from Bakkahöfði, phase 2. View 5 on photo 34 (Photo PCC SE).*

It can be assumed that the visibility of structures will be significant from sea where taller building will be visible from quite some distance. The structures are covered by land from most angles and do not extend over a large part of the hori□on above the shore. Effects from sea are therefore considered to have **negligible to considerable negative impact** depending on how close sailing is to the shore.

As previously mentioned the structures will be most visible from the national road, H□□insh□f□i and from areas above the plant, i.e. G□nh□ll, Skj□lbrekka and other areas in the western part of H□sav□kurfjall. In addition there is good visibility to the plant from Bakkah□f□i. As pictures 48-53 show, the obstruction of view is probably most from H□□insh□f□i when looking towards H□sav□kurh□f□i but the plant will not obstruct view except in a small manner when looking at Skj□lfandi from H□□insh□f□i 1 and 2.The effects from these areas are considered to have **considerable negative impact**. Further away from the plant the effects diminish rather quickly and become **negligible** when a distance of 5 km or more is reached.

The effects on population in H□sav□k are none, but the plant is visible from a walking path defined along the coast in the main urban development plan of Nor□ur□ing municipality. If viewed from Laugardalur towards the area the plant will be visible and the effects will have **substantial negative impact** when walking along the proposed industrial road past the plant towards Bakkah□f□i.

6.5.5 Mitigation measures - monitoring

When designing the structure and shaping of the land on the industrial site it will be attempted to reduce visual impacts as possible.

6.5.6 Conclusion

The effects of the silicon metal plant on the scenery are local, but their coverage is considerable within the property. Areas of particular value in regards to landscape are not disrupted. The effects are considered to have **considerable negative impact**, according to the definitions of weight ratings used in the EIA process, permanent but mostly reversible. The silicon metal plant will not touch the skyline from many viewpoints since the PCC plot is located in an incline and structures covered by land from most angles. Though, from the national road and partially from the farms H□□insh□f□i 1 and 2 the structures will touch the skyline or obstruct view. Obstruction of view is generally very little but in certain areas north of the plant there is some obstruction.

Visual aspects are considered to have **considerable negative impact**, permanent but reversible from areas north of the plant and above it, i.e. from the national road, G□nh□ll and other areas close to the plant. From areas further away from the plant, i.e. from H□sav□kurfjall the effects are less.

6.5.7 Review and comments on Landscape and Visual Impacts and PCC's answers

Residents and land owners of Héðinshöfði comment: "*The report states that the plant has a considerable negative impact, permanent but reversible. An explanation is requested on an impact that is permanent but reversible, and how likely it is after the construction of the plant that it will be removed so the impact will be reversible?"*

Answer PCC: This describes the results of the assessment of landscape and visual impact. The assessment is based on the assumption that if the operation is stopped buildings and traces on the site can be removed. In this respect, the effects are reversible. It is however claimed in the IEIS that despite this possibility, the impact has to be considered permanent, because long term operation is planned in the area.

Residents and landowners of H□□insh□f□i further comment *"Are there any plans to reduce negative impact such as visual […] impact on the residents of Héðinshöfði?"*

Answer PCC: During the final design of the plant measures will be taken to minimi□e the visual impact of structures, i.e. by choice of colours, vegetation, earth mounds as well as the installation of lighting. Also all structures will be lowered, if possible. However, a certain visibility of structures can always be expected, cf. model pictures in this report.

6.6 Archaeological remains

6.6.1 Assessment criteria

The impact on archaeological remains was assessed on the basis of the following criteria:

- Cultural patrimony Act no. 80/2012.
- Archaeological registration of remains

An archaeological survey was carried out and remains registered at each location. All remains found were given a number and/or sub-number. Written references were also used during registration, e.g. lists of natural artefacts, lists of preserved remains, etc.

It is worth noting that roads or other areas outside the project area were not surveyed, except for the area where remains no. 8, seen in **Figure 60**, was found.

According to the National Heritage Act, all remains older than 100 years are protected. They must not be damaged, destroyed, modified, covered, altered or moved, except with permission of the Cultural Heritage Agency of Iceland. If their safety cannot be assured or their distortion is inevitable, the Cultural Heritage Agency of Iceland must grant authori□ation. Project developer must also comply with any conditions that the Agency may set. If archaeological remains are found during construction, all work on site is to be suspended until the Agency's decision on whether and under what conditions construction can pursue.

6.6.2 Documents and studies

Two studies on archaeological remains have been conducted in the investigation areas that together provide a good overview and coverage of the construction site. The studies were carried out in 2012 by Bjarni F. Einarsson, archaeologist at the Archaeological Office (Fornleifafr□ □istofan) (Fornleifafr□ □istofan, 2012) and Oddgeir Isaksen, archaeologist at the Institute of Archaeology, Iceland (Fornleifastofnun □slands, 2012). The study carried out by the Archaeological Office concentrates on areas that are in the southern part of the investigation area, whereas the study by the Institute of Archaeology Iceland covers the northern part of the investigation area near River Bakka□. Both the survey of the Archaeological Office as well as the survey carried out by the Institute of Archaeology Iceland uses the National Heritage Act (no. 107/2001) as criteria, but the Act expired in January 1, 2013 with the entry of the Cultural patrimony Act no. 80/2012 into force.

A map of the area with the location of archaeological remains can be seen in Figure 60. The National Heritage Act was used as a basis for the archaeological registration, i.e. if remains were older or younger than 100 years. Many of the remains registered during the survey could be older than 100 years, i.e. from earlier than 1912, but the only way of assuring this is through analysis. For cautionary purposes they are regarded as protected remains. Decelrated protected remains have a 100 m sanctity □one from their outer perimeter, and for protected remains the distance shall be 15 m, except other is decided..

In the study carried out by Bjarni F. Einarsson, archaeologist at The Archaeological Office, the location, age and condition of archaeological remains were registered and a value assigned to each remain based on monumental and preservation importance. During registry, the Archaeological Office used the registration system already in use for the municipality. Assigned values are on the scale of 1 to 10 and values are categori□ed into *none*, *low*, *considerable* and *high*.

When assessing the risk that the archaeological remains are currently exposed to the □ero-option is assumed, i.e. other factors than the project itself was focused on. The project will have a significant impact on all of the remains, possibly with the exception of no. 8, but the construction process poses a certain danger which is assessed. This danger will disappear when the construction is finished, and the remains considered and/or appropriate mitigation measures applied.

The survey carried out by the Iceland Institute of Archaeology assesses the risk that archaeological remains are exposed to using the categories “great danger” (*icel*. st□rh□ tta) if the remains are located within the construction site and “danger” if the remains are in danger due to their proximity to the construction site.

The reports of The Archaeological Office and the Iceland Institute of Archaeology can be found in Annex 3.

6.6.3 Baseline

Total of 17 remains, or alleged remains, were found within the surveyed area. The location of all of the remains is displayed in Figure 60. No protected remains are in proximity of the studied area. A supposed □j□fadys is registered south of the area, but it was not found during the survey in 2012.

A total of eight remains were found within the south part of the area surveyed at Bakki by the Archaeological Office. On three of the locations remains older than 1900 were found. Other remains are probably younger, although this can only be verified through analysis. It is the archaeologist opinion that the preservation value of these remains is little. The highest heritage value has sites with alleged fox trap. The values of other remains are generally considered low. The conditions of the remains differ. According to expert opinion on the remains’ condition, one of the remains is in good shape, six of the remains are in reasonable shape and one is in poor shape. Risk and risk assessment is not based on the proposed project, but on other potential sources of danger. Animals, namely horses, are the main source of current risk to the remains. One of the remains is at risk due to erosion. Two of the remains are not believed to be at risk.

An expert from the Iceland Institute of Archaeology describes the conditions of the remains with respect to how grassy they are, if they are still standing or if they have sunk in whole or partly (see table 16). . In their expert opinion it would be feasible if the disruption of the remains could be prevented, e.g. by labelling them during construction. Where disruption cannot be avoided, The Cultural Heritage Agency of Iceland should be informed, which will then decide which mitigation measures are needed.

Archaeological remains were found outside of the project's impact zone. Most of the remains north of the surveyed area have been registered in relation to other projects. **Table 16** displays the results from the archaeological surveys performed south of River Bakka□. The registration numbers follow the numbering systems used by the Archaeological Office and the Institute of Archaeology Iceland in their reports.

6.6.4 Characteristics of impacts

There is a substantial danger connected to the construction of the Silicon Metal plant and it is evident that the construction will almost certainly disturb all remains within the construction site.

It is the Archaeological Office's assessment that none of the remains within the surveyed area is in need of protection.

The project is believed to have a direct and negative impact on all of the registered remains, with the exception of remains no. 8, which are nevertheless temporarily assumed to be in potential danger from the construction. This is assuming consideration of the remains during construction, taking appropriate mitigation measures if needed, and risk eliminated after construction.

According to the expert opinion of the Institute of Archaeology Iceland, the remains registered in the survey, located within the section of PCC's premises that are not investigated by the Archaeological Office, are in great danger due to construction. It is pointed out that damage to them should be avoided during construction if possible, for example by labelling. It is clear that in some cases it cannot be avoided to disrupt remains. In this case authori□ation from The Cultural Heritage Agency of Iceland is imperative as well as any mitigation measures they propose.

Table 16: *Main results of the archaeological surveys performed in relation with PCC SE's* Silicon Metal plant *at Bakki.*

No.	Type *	n	Risk	Condition	Age	Monumental value	Mitigation measures: Recommendations of the The Archaeological Office	Mitigation measures: Instructions of the Archaeological Office
2:1	Old path	1	Erosion	Bad	1550-1900	Low (3)	Low (3)	
3:1	Mound	1	Animals	Fair	1900-	Low (1)	Low (1)	
4:1	Housing remains	1	Animals	Fair	1900-	None (0)	None (0)	
5:1	Free range	1	Animals	Fair	1900-	Low (2)	Low (2)	
6:1	Mound	1	Animals	Excellent	1900-	Low (2)	Low (2)	
7:1	Free range	1	Animals	Fair	1550-1900	Low (4)	Low	
8:1	Mound (fox trap	1	None	Fair	1550-1900	Considerable (7)	Considerable (7)	
9:1	Mound	1	None	Fair	1900-	Low (1)	Low (1)	
SÞ-311:014	Old path (same as 2:1)	-	Great danger	-	-	-		GPS
SÞ-312:025	Sheepcoote ruins	-	danger	-	-	-		Complete investigation
SÞ-312:064	Burial site	-	Great danger	-	-	-		Complete investigation
SÞ-312:065	Burial site	-	Great danger	-	-	-		Complete investigation
SÞ-312:069	Burial site	-	Great danger	-	-	-		Complete investigation
SÞ-312:070	Burial site	-	Great danger	-	-	-		Complete investigation
SÞ-312:071	Burial site	-	Great danger	-	-	-		Complete investigation
SÞ-312:076	Burial site	-	Great danger	-	-	-		Examination ditch/ Complete investigation
SÞ-312:066	Ruin,	-	Great danger	-	-	-		Examination ditch / Complete investigation
SÞ-312:067	Mound	-	Great danger	-	-	-		Complete investigation

□The old path was not studied outside of the survey area.

Four remains have been registered in the area outside of the PCC site in relation to other projects and therefore are not considered to be in danger due to the plant's construction, but they might be in danger because of other projects. If the sea cooling alternative will be used, these remains will not be in danger. The points are shown in **Figure 60**. A summary of reference numbers and type of remains found outside PCC's plant site are shown in **Table 17**.

Table 17: *Archaeological remains outside of PCC's Silicon Metal plant site.*

No.	Type	Reference
SÞ – 312:025	Sheepcoote ruins	Fornleifastofnun Íslands, 2007
SÞ – 312:072	Mound, unknonwn	Fornleifastofnun Íslands, 2007
SÞ – 313:030	Sheepcoote ruins	Fornleifastofnun Íslands, 2007
SÞ – 312:031	Old path	Fornleifastofnun Íslands, 2007

6.6.5 Mitigation and monitoring

The impact on archaeological remains can be minimised by implementing the following mitigation measures as suggested by the expert of the Archaeological Office.

- Measuring Recording the location of the remains via GPS into the Icelandic system (Isnet-93)
- Digging an examination ditch, i.e. a cross section into the walls of the remains, and then applying the C-14 method to estimate the age of the remains and to find out if older remains are hidden underneath. The archaeologist does not assume that any remains can be found beneath the remains in question. .

- Recommendation to digging “security” holes at certain locations within the survey area to insure that no remains are hidden under fields that have been smoothed out.
- The only thorough investigation recommended by the archaeologist is on the alleged fox trap (no.8).
- Working sheds or other infrastructure should not be erected too close to archaeological remains. Road construction and machine operation should also be in consideration of all remains.

Upon request of the Planning- and building officer of Nor□ur□ing Municipality Fornleifastofnun □slands performed a study in the area, incl. the PCC site in the fall of 2012 (Fornleifastofnun □slands 2012 A). This was done in accordance with instructions from the Archaeological Office of NA Iceland on mitigation measures that were considered necessary before the construction could commence. The Archaeological Officer believed it to be necessary to dig examination ditches into the remains to determine on their age and nature as well as measuring their location using GPS. On some of the remains complete investigations should be made. Fornleifastofnun □slands conducted further studies in the fall of 212 and has issued a report with their findings (Fornleifastofnun □slands, 2012 A).

Mitigation measures for remains in Table 16 are instructions from the Archaeological Officer of NA Iceland. The results of the examinations on the age and the role of the remains have been sent the Archaeological Officer for review, but the Officer’s results if the mitigation measures are adequate are not yet available.

If it proves necessary to disrupt any of the remains with low preservation value the only necessary mitigation measures are the digging of examination ditches. Those actions require authori□ation from The Cultural Heritage Agency of Iceland and the enforcement of their terms.

6.6.6 Conclusion

In total, seventeen remains or alleged remains were found in the surveyed area. Even though the Institute of Archaeology Iceland and Archaeological Office do not weigh the impact on the same scale, the result is the same neither oppose construction in the area.

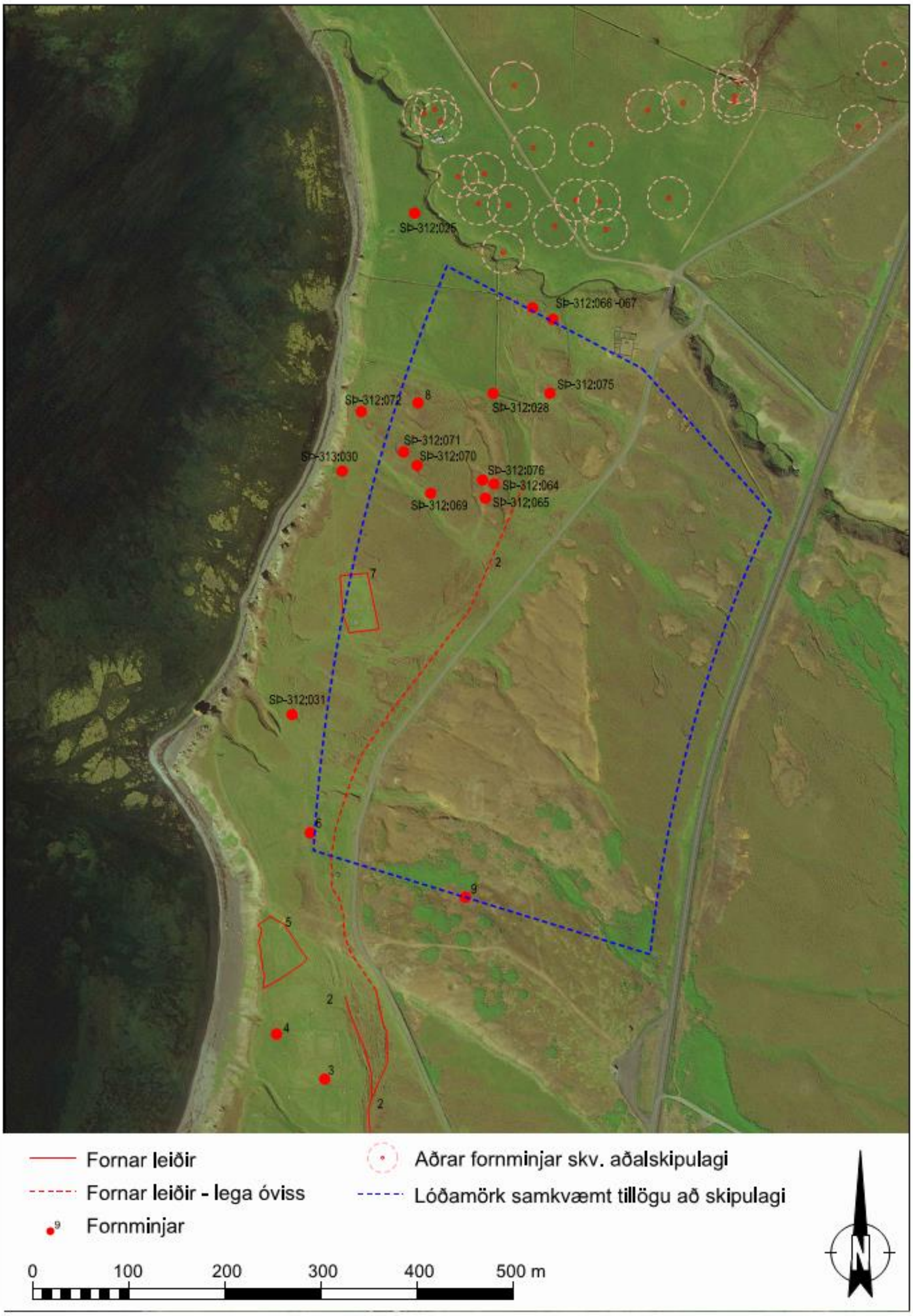


Figure 60: *A map showing the premises of PCC's silicon metal plant, showing locations of archaeological remains found during survey and previously registered remains in relation with other projects.*

If disruption cannot be avoided The Cultural Heritage Agency of Iceland will decide on appropriate procedures and possible mitigation measures

Considering the conservational value of the archaeological remains found on site and the characteristics of the impact, it is regarded as ***negligible*** given that all mitigation measures mentioned above will be implemented.

6.6.7 Review and comments on Archaeological Remains and PCC's answers

The Cultural Heritage Agency of Iceland comments*: "In the IEIS there are two tables, Table 15 [comment EFLA: now Table 16] that shows the main results of archaeological studies in connection with the construction of the PCC Silicon Metal plant at Bakki and table 16 [comment EFLA: Table 17] that shows archaeological remains outside of lot of the plant. Figure 13 in the IEIS shows the boundaries of the construction area and Figures 3 and 60 show the boundaries of the lot. If those figures are compared, more archaeological remains seem to fall outside of the PCC lot than listed in Table 16."*

The Cultural Heritage Agency of Iceland further comments*: " In the discussion on SÞ-312:068 above it is stated that it may be the case that this is the same remains as number 8:1 in the report of the Archaeological Office. Their position on aerial photographs seems to be the same. The remains of SÞ-312:068 were investigated and were found to be a collapsed milestone. In the report of the Archaeological Office it is assumed that 8:1 could be a fox trap. The IEIS suggests that the fox trap is examined in a complete investigation. The Cultural Heritage Agency believes it has to be made sure if those are the same remains and if they have been fully studied. If the alleged fox trap is still undisturbed it has to be fully investigated."*

The Cultural Heritage Agency of Iceland makes no further comments on the EIA of the project. It should be noted that Article 21 of Act nr. 80/2012 on cultural objects says i.e. "Archaeological remains cf. Article 3(3), both those who have been protected as cultural patrimony and those protected by age, may not be damaged, destroyed, modified, covered, altered or moved by land owner, resident/farmer, developer or anyone else, except with the permission of The Cultural Heritage Agency of Iceland. And, to Article 24(2) of the same Act which reads as follows:" If previously undiscovered remains are found during the execution of work, work shall be stopped immediately. The Cultural Heritage Agency of Iceland shall have a site survey conducted without delay so the nature and extent of the findings can be determined. The Agency shall determine as soon as possible if work can be continued and under which conditions. It is forbidden to continue work without the written permission of The Cultural Heritage Agency of Iceland.

Answer PCC: The points marked as other archaeological remains on the maps were taken from the municipal plan to provide an idea of locations of other archaeological remains located near the construction area, and therefore their position on the map is not precise. The points in question are points nr. S□-312:028 and S□-312:030 (called 313:094 on the map due to wrong registration in the reference). Also point S□-312-025 falls out in Table 16 due to double registration. An updated map of archaeological remains is shown in the EIS. In other terms the developer agrees on the comments and suggestions of The Cultural Heritage Agency. The alleged fox trap will be investigated further and a complete investigation made if it turns out that the remains are disrupted. If other, previously undiscovered remains are found, work will be stopped until a site survey on behalf of The Cultural Heritage Agency of Iceland has been carried out and work will not be continued unless with a written permission of The Cultural Heritage Agency of Iceland.

6.7 Social impacts

6.7.1 Assessment criteria

The assessment of the social impacts following the construction and the operation of PCC's Silicon Metal plant focuses on population development, the labour market and on the municipalities in the region.

6.7.2 Documents and studies

The assessment of the social impact is based on an infrastructure analysis prepared by Northeast Iceland: "*Greining innviða á Norðausturlandi. Unnið vegna undirbúnings að uppbyggingu orkufreks iðnaðar í héraðinu skv. viljayfirlýsingu stjórnvalda og sveitarfélaganna á svæðinu dags. 25. maí 2011*" (Northeast Iceland Development Agency , 2012)

The results of the IEIS for the 346,000 tpa Alcoa aluminium smelter from 2010 (HRV, 2010) are also considered.

6.7.3 Baseline

The subject area for the Northeast Iceland infrastructure analysis is divided into three areas: the Húsavík area or the "near region", and two far regions; the Akureyri region and the Northeast corner, see **Figure 61**. In the opinion of the authors of the infrastructure analysis both Kópasker and Raufarhöfn lie outside of the defining parameters of the "near region", providing a "*more realistic assessment of existing conditions and the measures necessary to reinforce infrastructure and stimulate growth in the regional labour market*". (Northeast Iceland Development Agency, 2012).

The subject area defined in the in the IEIS for the aluminium smelter (HRV, 2010) was different, since it defined the western part of Eyjafj□r□ur up to Siglufj□r□ur municipality as investigation areas. Also the Melrakkasl□tta area with the villages of K□pasker and Raufarh□fn, was defined as near region.

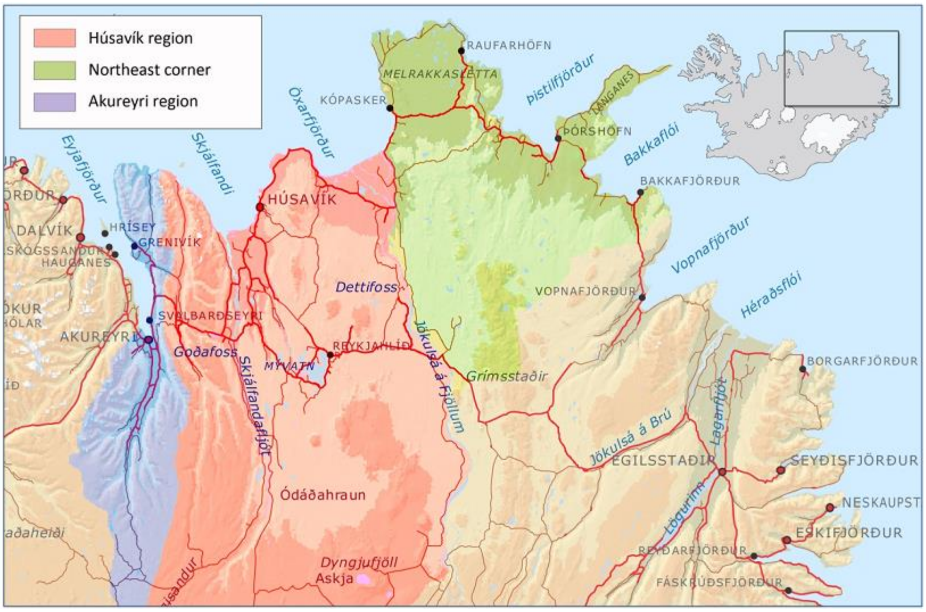


Figure 61: *Subject area for the infrastructure study for Northeast Iceland (Northeast Iceland Development Agency, 2012).*

The recent infrastructure analysis shows that the population development in the total subject area of Northeast Iceland has been positive over the past decade (□6.4□ or an increase of 1,397), although below the total population increase in Iceland (□12.4□).
Individual regions within the subject area show disparity in the development. In the H□sav□k area, there was a decline of 9.6□ over the same period (-422) and in the far region of the

pcc SE

Northeast corner the population decline was by 21.9□ (-260). At the same time in the far region of Akureyri and vicinity, the population increase was around 12.9□ (2,079).
The total population of the H□sav□k near region was 3,977 residents in January 2011, of which 2,237 resided in the town of H□sav□k. The total population in the area had declined by 422 during the previous 10 years, thereof 186 in H□sav□k. The population decline consists mostly of young people with children, as shown in the age pyramid (Figure 62),

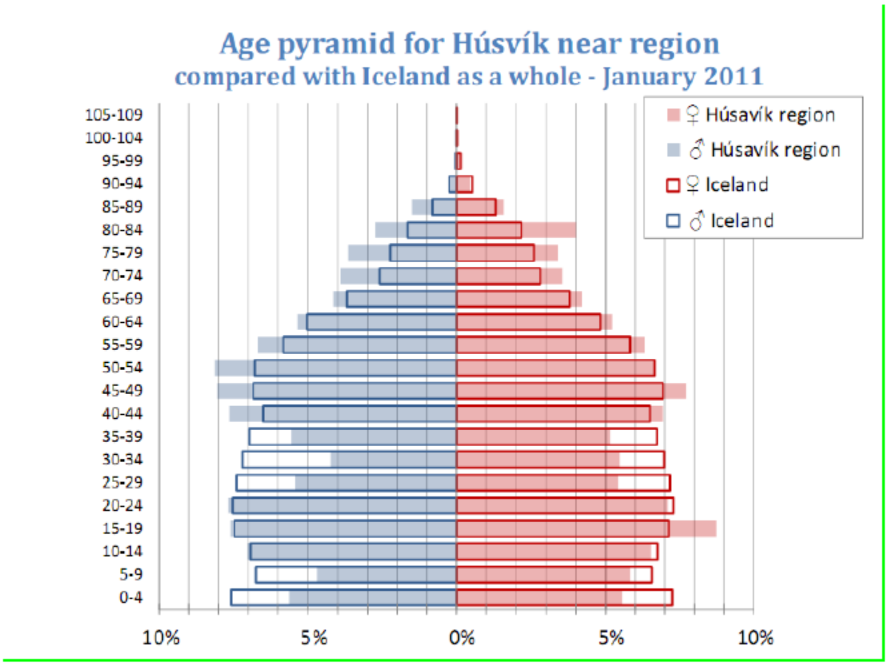


Figure 62: *Age pyramid for Húsavík region compared to the total population of Iceland* It shows a deficit in the number of children under the age of ten as well as in people in the age group from 25 to 40, *(Northeast Iceland Development Agency, 2012).*

The number of children (0-10 years old) in H□sav□k decreased by 32.6□ and the reduction in people between 25 and 40 was 30.3□. In the age group above 45, the ratio of people has grown. This large gap in the age groups between 25 and 40 in the H□sav□k area is a common characteristic of areas with declining population (Northeast Iceland Development Agency, 2012). .The labour market of the H□sav□k area has been defined as an urban commuting region, i.e. an area where people travel between home and workplace at least once on a daily basis. According to the definition, the commuting region of H□sav□k reaches to Lj□savatnsskar□ pass in the west, M□vatn region in the south and as far as Kelduhverfi in the east, an area conforming fairly well to the area defined as near region on Figure 61 (Northeast Iceland Development Agency, 2012).

The population of the entire study area on January 1, 2011 was 24,152, which constitutes a fairly large labour market on an Icelandic scale, in fact the largest outside the capital area. Of the total population, 16,922 people were of working age (16-74 yrs.). Given the activity rate, which is the ratio of the labour force to the total population of working age estimated by Statistics Iceland, the labour force can be estimated at 13,700 in the study area. In the near region, which largely corresponds to the H□sav□k commuting region, the population was 3,977 on January 1, 2011. The working age population (16-74 yrs.) was 2,852, indicating a labour force of around 2,300. On January 1, 2011, the total population of the Akureyri region was 19,249 of which 13,419 were of working age, i.e. an estimated labour force of about 10,900. In the Northeast corner, the total population was 926 of which 651 were of working age giving an estimated labour force of about 530 (Northeast Iceland Development Agency, 2012).

Within the total labour force in Iceland in 2010, 35□ had compulsory education, 37□ upper secondary education and 28□ tertiary level education, according to Statistics Iceland. In a study conducted by The University of Akureyri Research Centre (RHA) on the social impacts of the aluminium plant in East Iceland 2002-2008, Northeast Iceland was within the study area [35]. Though the findings should be interpreted with some reservation due to the small sample size, they do indicate a certain variation from the national level within the labour force. According to the study, 44% had completed the compulsory level, 30% upper secondary level and 26% tertiary level education. While no conclusive factor can is given, one contributing factor could be the age distribution, since the educational level is generally higher among younger adults, which is the age group notably below national mean in this region (Northeast Iceland Development Agency, 2012).

Information on unemployment is only gathered for larger areas of Iceland. The Directorate of Labour calculated the unemployment rate from available information at the end of each month for the period 2010 to November 2011. During that period the unemployment rate in the region went down considerably. The rate remained lowest in the Húsavík region, where the 12 month mean was 5.0%, while the rate was 6.0% in the Akureyri region and 6.8% in the Northeast corner. Unemployment rate was higher among women than men in all three regions. The gender difference is greatest in the Northeast corner. (Northeast Iceland Development Agency, 2012).

Assuming status quo, major changes in the regional economy are not foreseen in the near future though some indicators point to an increased number of jobs rather than a declining labour market. This will for the most part be determined by the national economy in general but on a regional basis there are also expectations for increased tourism in the near region and outlook is also good for fish farming and fish processing in the region.

The subject area covers 10 municipalities with various population and development levels. Consequently, the level of service and administration is different between municipalities but cooperation between them ensures effective access for all residents. With the main impact being in the near region the main focus here is set on that area. The near region has five pre-primary schools or programmes connected with compulsory schools which combined can accommodate over 200 children. One pre-school is operated in Húsavík which is operated close to its maximum capacity and cannot accommodate an increase of enrolment without expanding facilities and teaching staff.

Five comprehensive schools with grades 1-10 for children aged 6-15 are operated in the near region. As a result of a greatly reduced number of students in the near region, the schools have the capacity to meet an increase of almost 60% without having to expand. In the two schools closest to Bakki alone, the unused capacity in the present facility is close to 160 students.

Two upper secondary schools operate within the near region. Nearly 150 students attend the Húsavík Upper Secondary School, thereof 110 attending day school. The current facility could accommodate double the current day school students or 220 in total.

The nearest institution for higher education is the University of Akureyri, with around 1,500 students.

A hospital is located in Húsavík, with smaller Health Centres in other densely populated areas. The hospital provides general health services and dental service. The facilities are well equipped in terms of facilities and could accommodate additional work load such as in emergency reception, which however would require increased staff and employment ratio for various specialists. Industrial development in the area will likely add increased pressure on health service in the area, particularly during the construction phase. It is therefore necessary to increase the capacity of the local health service to achieve acceptable response time in incidents such as accidents and emergencies.

6.7.4 Characteristics of impacts

The construction of the Silicon Metal plant will create around 200 man-years during the construction period. Most of the jobs during the construction are temporary, partly manned with people from other areas and therefore unlikely to have a great impact on the population.

The construction of the silicon metal plant is considered to have a temporary positive impact on population development.

The workforce during construction will come from the local areas as well from other parts in Iceland, but the ratio is dependent on conditions of the country's labour market. A low unemployment rate can lead to more immigration of workforce, either from other areas or from abroad. The construction of the Silicon Metal plant is considered to have temporary positive impact on the labour force.

The construction of the Silicon Metal plant will have a positive effect on the nearby municipalities, due to increased income through labour, more employment and higher income. An increased demand from people working on the construction will lead to an increase in commerce and service. During the construction time, increased pressure on the service of the municipalities is to be expected, especially in health services. The infrastructure is capable of managing increased demand during the construction. The main need for labour increase will be within the health services to achieve acceptable response time when incidents occur. The impact on the municipalities during the construction time is therefore expected to be a temporary but substantial positive impact.

The operation of the Silicon Metal plant will provide jobs in the area and provide a basis for a positive population development, but as described earlier the population in the Húsavík area has been declining for the past decade. In the IEIS for the aluminium smelter, each job at the aluminium smelter is assumed to increase the number of inhabitants by 4-6 (HRV, 2010). Assuming the operation of the plant will create 127 new direct jobs, an increase in the population can be between 500-750 inhabitants if using the same assumption. It is to be expected that this will have an impact on the wider NE-area, though the greatest impact will be in Húsavík and in the Húsavík region.

The operation of the Silicon Metal plant will provide opportunities, especially for young adults, reducing the number of them moving away to other areas and also providing possibilities for people to return. Therefore, the operation of the plant is considered to have a substantial positive effect on population development in the area. In total, the operation of the plant will create about direct 127 new jobs, not including other jobs created indirectly in relation to the operation. Of the 127 jobs, 27 are administrative, 8 are in raw material handling, 63 belong to supervision and operation of the furnace, tapping and operation of the casting bay, dedusting and product handling, 15 are meant for technicians (mechanics, electricians and welders), 8 are for laboratory personnel and 6 for other purposes.

The major impact will be on the local labour market since most of the personnel will come from within the study area. Therefore the operation of the Silicon Metal plant will have a substantial positive impact on the job market, both directly and indirectly.

Based on the status of the regional economy, particularly for the near region, it is clear that job opportunities connected with new industrial development will to some degree draw labour from other sectors in the region (crowding-out effect). The degree of this effect will be determined by the competitiveness of the new industry with regards to employee facilities, wages and benefits. Most of the new jobs will, however, be filled by migration of people who come to work in the new industry or to fill crowded out jobs in existing sectors (Northeast Iceland Development Agency, 2012).

The IEIS for the aluminium smelter (Alcoa 2010) points out that the infrastructure of the municipalities in the subject area is very well capable of receiving new inhabitants in the area. With a smaller size of the Silicon Metal plant, this impact will be even more manageable and the only increase needed is within the health services to achieve acceptable response time when incidents occur. The income of the municipalities will increase substantially, through increased taxes from direct and indirect creation of jobs, and also from land and property tax and through fees from the harbour. The operation of the Silicon Metal plant on the municipalities is therefore considered to have a substantial positive impact for the long term.

6.7.5 Mitigation and monitoring

No mitigation or monitoring measures are suggested for social impacts.

6.7.6 Conclusion

The construction and operation of the Silicon Metal plant is expected to cause a ***considerable positive*** impact on both population development as well as a considerable positive impact on the municipalities due to increase in income, the labour market and increase in trade and commerce.

6.8 Environmental impact during construction

6.8.1 Assessment criteria

The assessment focuses mainly on temporary impacts on the residents of H□sav□k and nearby areas during construction, mainly due to noise, risk and safety and air pollution. The construction period entails both the construction of the plant and related constructions, such as the extension of the harbour area. It is assumed that a new access road will be ready when construction begins, if not the current public road from the harbour to the area will be used.

The impact is furthermore assessed on the basis of the following laws and regulations:

- Regulation no. 724/2008 on noise at industrial areas
- Law no. 46/1980 on facilities, health and safety in work places
- Regulations on explosions no. 684/1999

6.8.2 Documents and studies

The temporary environmental impacts during construction are assessed on the basis of previous constructions in Iceland, in particular roadwork and other plant construction.

6.8.3 Baseline

The proposed Silicon Metal plant is located approximately 2.6 km north of the village and port of H□sav□k. The current harbour is mainly used for the fishing industry, shipping, shipbuilding, tourism and repair. In the municipal plan from 2010 – 2030 an expansion of the harbour is planned in order to support industries in the new industrial area north of H□sav□k. The planned industrial area is accessible from the harbour via residential roads and a national road, lying through H□sav□k.

6.8.4 Characteristics of impacts

Road construction and improvements in the harbour area are constructions of the municipality for the industrial area at Bakki. Those activities is connected to the operation of PCC but not performed by the company. This infrastructure can also be used for other operations in the area.

Environmental impacts during construction of the plant will mainly be due to noise and air pollution from traffic, the operation of heavy machinery and explosions in bedrock during construction of the plant.

The northernmost houses of H□sav□k are situated approximately 1.2 km away from the south border of the plant's site and to the north the farm Héðinshöfði is located around 2 km from the site. It can therefore be assumed that noise from the plant's site will not be audible to inhabitants of H□sav□k and nearby areas. Noise from explosions, which mostly be carried out during the first phases of the constructions, might however be heard and have a temporary negative impact. Due to distance to the nearest buildings no impacts will occur due to vibration caused by blasting or earthworks. It is not assumed that noise from the construction will cause disturbance to neighbours.

It is unlikely that air pollution due to the operation of heavy machinery during earthworks and excavations on site will affect residents of H□sav□k or nearby areas. During hot weather periods, earth works and transport of materials can however cause dust pollution. Also, there is a risk of dust getting suspended into the air from areas that are not covered with vegetation or uncovered material mounds. Mitigation measures will be used to reduce all dust pollution from the plant’s site during and after construction, such as covering trucks travelling with materials and covering or watering eroded areas on site to control dust pollution it deemed necessary due to weather conditions.

A substantial amount of traffic due to transport of building materials and equipment is to be expected, mainly from the harbour site.

The plant’s construction is expected to take 18 months.

The port extension and the new industrial road connecting the harbour to the plant are planned for construction and completion prior to the construction of the Silicon Metal plant, in order to minimi□e disturbance to the residents of H□sav□k municipality and nearby areas. Should there however be a delay in its construction, it will start at latest in parallel with the plant’s construction, causing a temporary negative impact to Húsavík residents due to reduced traffic safety, noise and air pollution following frequent transport. When the new industrial road has been finished, transport will be moved over to that road, significantly reducing the impact on residents.

Excavated material from the plant’s site will be used for the final landscaping and preparation of the site before starting the operation. Soil materials intended for concrete production, foundations and road construction will mostly come from the plant’s site. If needed, materials will also be taken from local mines with operation permits. A work camp will be erected on site during the plant’s construction, but existing infrastructure in the H□sav□k area will be used for workers accommodation and services. The facilities on site will be used for coffee breaks, toilets and offices for site engineers and supervision.

It is also assumed that staff staying in the area temporarily can also stay there over night.

6.8.5 Mitigation and monitoring

In order to minimize impacts on residents of Húsavík during the plant’s construction, the following mitigation measures will be taken:

- Traffic through residential roads in H□sav□k will be avoided by using a new industrial road that is to be built prior to the plant’s construction. Should there be a delay in the road’s construction, when driving through Húsavík, measures will be taken to reduce speed and therefore reduce traffic risk for residents and its negative impacts. The new industrial road will be used as soon as ready.
- Dust pollution will be avoided by covering truckloads carrying building material. Dry and eroded areas will be sprayed with water to prevent dust from spreading during dry periods of the plant’s construction.
- Requirements of regulation no. 724/2008 on noise apply close to or within residential areas. Article 8 specially requires all noise disturbances from construction to be reduced. Also, that construction in or close to residential areas is evidently introduced to the nearby residents before starting the construction. This introduction shall include information such as the duration of the construction, which part of the work is likely to cause the most disturbances and when work on those parts takes place. According to Table IV of the Annex to the regulation, loud construction works shall be limited certain periods of time. These rules will be complied with as relevant for the constructions.
- Strict rules apply on the work and handling of explosives. When preparing tender documents for the construction relevant clauses will be set that bind the contractor working for the comply with those rules. Article 38 of regulation nr. 684/1999 on explosions reads: “When it is to be expected that explosions can cause disturbance to close residents, these should be notified”. Therefore, all residents close to the area where explosions will occur will be specially notified.
- The construction site will be marked and clearly delineated. The developer will insure that the contractor complies with laws and regulations regarding the working hours and noise and air pollution.

6.8.6 Conclusion

Considering the above criteria, characteristics of the impact and mitigation measures taken, and assuming that the new road from the harbour to the plant's site is ready before beginning plant construction, it is the view of the developer that the project will have an ***insignificant negative*** effect on H□sav□k residents and nearby areas during the plant's construction, mainly due to noise and air pollution. This impact is increased to temporary ***considerable negative*** impact if the new road is not ready before beginning plant construction, due to decreased traffic safety and increased noise and air pollution.

6.8.7 Reviews and comments on Environmental Impact during Construction and PCC's answers

Residents and landowners of Héðinshöfði ask in their comments: "*What are the emissions of machines and vehicles during the construction period […] and that is the impact on residential areas, cultivation of land and agriculture at Héðinshöfði?"*

Answer PCC: The release of airborne emissions from machines and vehicles during building time has not been specially evaluated. The scale of the project is large, both in terms of landscaping as well as construction of buildings and therefore it is clear that there will be a considerable use of fossil fuels. However, care will be taken to reduce driving of heavy vehicles as much as possible, thus reducing the use of fossil fuels.

Furthermore, residents and landowners of H□□insh□f□i comment: *"Environmental impact during construction and after the plant is in full operation will inevitably have a great and permanent impact on animal life, nature and people. The increase of traffic and inconvenience caused to the inhabitants of Héðinshöfði, who are the neighbours of the silicon metal plant in 2 km distance, are not mentioned. It is demanded that the impact on residential areas, land cultivation and agriculture at Héðinshöfði are fully considered during the building time and during operation of the plant".*

Answer *PCC:* Transportation between the harbour area and the industrial area will be directed on an industrial road to prevent it from going through the town of H□sav□k. Transport of materials to and from the plant will not be directed passed the farmhouses of H□□insh□f□i. Traffic that passes H□□insh□f□i could be cars of employees or visitors and transport of delivers related to office operation and canteen, but likely on a very small scale, since it is assumed that the plant is largely serviced from H□sav□k. It is estimated that there will not be a significant increase in traffic from the traffic that already drives on Tj□rnesvegur road. It is also likely that employees will carpool and so reduce traffic.

Furthermore, residents and landowners of H□□insh□f□i ask: "*What will happen to excavated material from the industrial area? Where is it foreseen that construction material will be taken for constructions in the PCC industrial site?"*

Answer PCC: It is expected that excavation material will be used within the site, i.e. for landscaping. Also, a part of the excavation material will be used in projects by the municipality if needed. Material will mostly be taken within the site and from nearby mines with valid operational permits.

6.9 Risk and safety

6.9.1 Assessment criteria

The assessment of the impact due to the emerging risks at Bakki is based on the following Icelandic acts and regulations:

- Building regulation nr. 112/2012.
- Act on fire safety nr. 75/2000 with subsequent updates.
- Act on structures nr. 160/2010.
- Regulation concerning usage of equipment that burns gas nr. 108/1996.
- Regulation concerning catastrophes nr.160/2007 (Seveso).
- Act on protection against ocean and shoreline contamination nr. 33/2004.
- Regulation concerning operations that may cause pollution nr. 785/1999.
- Regulation concerning explosive atmosphere in workplaces nr. 349/2004.
- Regulation concerning equipment and protection systems in explosive atmospheres nr.77/1996.

6.9.2 Documents and studies

The assessment of risks and possible environmental impacts due to them is based on the following documents.

- P□ll Halld□rsson 2005: Earthquake activity in NA Iceland. Prepared for the Ministry of Industry by the Icelandic Met Office.
- Ragnar Sigbj□rnsson and J□nas □□r Sn□ bj□rnsson. Earthquake ha□ard - Preliminary assessment for an industrial lot at Bakki near H□sav□k. Earthquake Engineering Research Centre, University of Iceland.
- H□sav□k fire brigade. Fire safety program. H□sav□k, Nor□ur□ing, Iceland.

Furthermore to the documents listed above, information from other chapters of this report is used as basis for the assessment of risks and safety.

6.9.3 Characteristics of impacts

The planned operation of the Silicon Metal plant at Bakki accommodates the need for assessing the risks to the health of people and safety of the environment.

There is a risk of explosions both where LPG is stored and in the coal and woodchip storages where there is a risk of dust explosion. Due to the storage of LPG, oxygen and refractory material linings, regulation no. 160/2007 concerning the risk of catastrophes may apply to the operation planned at Bakki, depending on the maximum amount of material in stock.

Transformers, very large fuel loads in storage facilities and the storage of LPG and Oxygen call for significant response capability and capacity of the fire brigade.

The operation is planned in a seismic region where there is a present risk of earthquakes occurring cf. preliminary assessment for an industrial lot at Bakki, H□sav□k (P□ll Halld□rsson, 2005, Ragnar Sigurbj□rnsson og J□nas Sn□ bj□rnsson, 2007).

Other natural catastrophes such as avalanches and volcanic eruptions cause very low or no threats to the operation.

6.9.4 Mitigation and monitoring

To mitigate the apparent and emerging risks and to ensure that they are dealt with appropriately, risk management will be applied. The procedure will be according to ISO 31000.

Performance based fire safety design and a risk analyses will be carried out for the appropriate buildings according to article 9.2.4 of the Icelandic building regulation nr.

112/2012. Where regulations and appropriate EN standards are not sufficient, the design will be based on the applicable NFPA standard or calculations based on widely recognised methods.

Storage of flammable gas will be in an isolated storage according to article 12.6 of the Icelandic building regulation nr. 112/2012 and is subject to approval of local authorities according to article 6.11.4 of the same regulation. Where there is a risk of explosion, requirements for pressure relieving systems and structural integrity stated in article 9.4.13 of the Icelandic building regulation nr. 112/2012 will be satisfied. Risk analyses will be carried out for the buildings to minimize risks due to radiation, smoke, toxic gases or explosions according to article 9.2.4 of the building regulations nr. 112/2012.

Location and storage construction for LPG pressure containers will be according to NFPA 58-59, as there are not appropriate EN standards available. LPG pipe systems only extend from the storage facility to a single location within the plant, threats due to transport of LPG within the premises are therefore localised. The general application of instruments that burn LPG will satisfy requirements of regulation nr. 108/1996. On the location, venting, signs etc. in oxygen storages reference will be made to relevant NFPA standard, in lack of appropriate ÍST EN standard.

There is a risk of explosions both where LPG is stored and in the coal and woodchip storages where there is a risk of dust explosion, this needs to be accounted for in the design of these storages and their surroundings. General design of storage facilities, electrical design and design of systems for the prevention/mitigation of explosions reference will be made to EN 16020:2011, EN 14491:2012 and EN 14034-1, 2, 3, 4. Where EN standards are not adequate, reference can be made to NFPA 499, 68, 69 and 77. For compartments where there is a risk of explosion either because of flammable gas or dust, the operation will satisfy the requirements set by regulation nr. 349/2004 concerning explosive atmosphere in workplaces. For such compartments the operation will also satisfy the requirements of regulation nr. 77/1996 concerning equipment and systems for use in potentially explosive atmosphere, as required by risk analysis according to regulation nr. 349/2004.

Detection, alarm and suppression systems, egress paths, smoke control, fire fighting facilities, structural fire design and other special requirements made by the Icelandic building regulation nr. 112/2012 will be satisfied. Detailed fire safety design will refer to the appropriate EN standards. Design of automatic suppression systems will be according to EN 13825 Fixed fire fighting systems — Automatic sprinkler systems, directions for applying sprinkler protection and other instructive documents subject to approval of local authorities.

To control risks due to an earthquake, structures will be designed for the appropriate seismic loads according to EN standards including national annexes. LPG pipe systems and systems that contain toxic gases will be designed with special emphasis on earthquakes according to appropriate EN standards including national annexes.

Risk analyses will be carried out where the health of people, property and the environment can be affected by exhausts, waste, gas leakage or other factors. Response plans will be made for the whole operation with special emphasis on the components that cause risk to people, environment or operation during and after an earthquake, for example gas leakage and undesired waste or air pollution.

The fire brigade in Húsavík does not currently have the capacity to deal with the emerging new risks, planned at Bakki, both with respect to manpower and equipment. The enhancement of the fire brigade and necessary fire fighting water should be decided with respect to what extent the fire protection on site will be and the storage layouts. Transformers, large fuel loads in the storage facilities and risk of explosions call for significant response capability and capacity of the fire brigade and therefore a detailed response plan will be made for the factory and related operations such as transportation and port activities. To ensure sufficient capacity of the fire brigade, the following should be implemented:

- Adding, renewing and maintaining fire fighting vehicles.

- Adding, renewing and maintaining equipment such as pumps, clothing, smoke diving gear and IR cameras.
- Telecommunications equipment.
- Adding manpower, training and retraining.
- Fire safety monitoring.
- Adding, renewing and maintaining equipment to deal with pollution incidents.
- Securing enough fire fighting water, capacity and pressure.
- Securing necessary amount of fire fighting foam and other means of special fire fighting materials.

To fulfil requirements set out in part b of Annex I in Act nr. 33/2004 on prevention against sea and costal pollution and regulation 468/1998 on response to acute pollution of the sea, PCC will have to prepare a response plan on acute pollution of the sea before applying for an operation permit. A risk analysis will be carried out and appropriate measures undertaken to control risk and ensure that the risk of resources contaminating the ocean during loading and unloading is minimised and to prevent environmental impact and pollution due to port activities. PCC will also provide a confirmation of necessary insurance in accordance with article 16 of act 33/2004 and article 3 of regulation 1078/2005 on the insurances of ships and operations on land due to acute pollution. No raw materials transported through the port and used by PCC can cause acute pollution of the sea. Oils within transformers and fuel oil will be kept on site and proper safety cautions will be carried out for those and appropriate ADR certificates will be acquired for all transport and handling.

Storage limits according to regulation nr. 160/2007 concerning the risk of catastrophes compared to annual material usage for the operation is shown in Table 18.

Table 18: *Storage limits according to regulation nr. 160/2007 and storage quantities on site.*

Substance	Storage Limit	Storage quantity on site
LPG	5 tons	90 tons (one month supply)
Refractory material linings	5-50 (depends on type of material)	-
Oxygen	200 tons	70 tons (two months' supply)

Annual quantities of the above mentioned materials are above the threshold limits stated in the catastrophe regulation nr. 160/2007, therefore the arrangement of supplying resources will control whether the catastrophe regulation applies.

If materials are stored in greater quantities than regulation nr.160/2007 states as threshold limits, appropriate measures for reporting obligations, planning and reaction to catastrophes, safety management systems and safety reports will be undertaken according to the regulation.

6.9.5 Conclusion

With appropriate measures such as mentioned above, carrying out risk analyses and controlling risk, implementing proper design methods according to relevant standards, reinforcing the fire brigade at H□sav□k and by following regulations strictly, the emerging risks due to the planned operations at Bakki can be minimised and the environmental impact due to ha□ardous events kept to a minimum. With this in mind the impacts are regarded ***insignificant***.

7 ENVIRONMENTAL IMPACT ASSESSMENT – OTHER ALTERNATIVES

7.1 Sea water cooling

7.1.1 Air quality and climate

The impact of the alternative of using sea water cooling on air quality and climate is considered the same as for alternative 1. See chapter **Error! Reference source not found.**.

7.1.2 Noise

If sea water is used for cooling, a cooling tower will not be required, thus decreasing noise within the site. Noise calculations were performed for alternative 1 and the respective noise maps are located in Annex 11.

7.1.3 Marine and coastal areas

7.1.3.1 Assessment criteria

During the production process at PCC's Silicon Metal plant, considerable heat is formed which requires substantial amounts of water for cooling purposes. The concept of this alternative of cooling is the use of sea water which is collected outside the shore, close to the plant, see chapter 3.1. For the first phase the use of sea water for cooling is on average 1,200 m^3/hour. The cooling system is operated as a closed system where the sea does not get into contact with polluting compounds during the cooling process, as this would be harmful for the production. A pumping and inlet station would be installed on the shore, approximately 6 m below sea level. The preliminary design is to excavate two 15 m wide channels and refill them with fine material in the core and course protective material on the outside. Seawater is filtered through these channels and used for the cooling process. After the cooling process, sea water would be returned to the sea at a temperature between 16-25C.

A water outlet pipe then lies along either channel on the seabed, with the outlet located 20-40 m beyond the coast line, at approximately 5 meters depth. The instalment would require a 10 m wide disruption of the sea floor, including a gradually decreasing wave breaker going further into the sea. The cooling water would be released from the pipeline through diffusion noles, to ensure an even distribution of heat to the sea.

This option can cause effects due heat dispersion from cooling water and direct effects on the biota at the coast of Bakki.

The project's impact on marine and coastal areas is assessed on the basis of the following criteria:

- Act no. 44/1999 on nature conservation.
- Act no. 33/2004 on prevention of marine and coastal pollution.
- Regulation no. 798/1999 on sewer and sewage

7.1.3.2 Documents and studies

The effects of releasing warm sea water into the sea were analysed, both close to the outlet and at the surface, by means of calculations with a simple dispersion model created by Verkfr istofa Norurlands based on Dr. Jacob Odgaard formulas (DTU 1970)/K. The main assumptions for the calculations are the following:

- Water cooling system: sea water at an inlet temperature of 5C
- Temperature in outlet: 20C
- Sea returned at seabed at 5 m depth (around 20-40 m from coastal line)
- Flow: 1,200 m^3/hour (333 L/s)
- Cooling system power demand: 21 MW
- Number of diffusion noles: 3 (horiontal flow). Flow through each nole is 400 m^3/hour (111 L/s).

- Diameter of no□□les: 0.27 m
- Distance between no□□les: 2.6 m
- Temperature of the receiving sea at the outlet (at seabed at 5 m depth) of 5□C

7.1.3.3 Baseline

For the calculations the average temperature of the seawater at the north coast of Iceland is used. It is clear that sea temperature changes with the seasons of the year, but this has proven not to affect the results of the calculations.

The southern part of Bakkakrókur, i.e. the shoreline outside PCC's allocated plant, extending from River Bakk□ south to Forva□i (see Figure 22), is a rock-bound or boulder shore. Similar shores can be found south of Cape Bakkah□f□i, and north of capes H□□insh□f□i and Lyngh□f□i. These shores have solid bases and are very flat, resulting in very long and shallow shores. Gravel of varying grain si□e can be found along above the coastal line in the south part of Bakkakr□kur, reaching up to a grassy bank. There is also a patch of drifted seaweed that has accumulated in strong tidal currents, and spots of sand in between, especially in the lower part of the shore, see **Figure 63** (□orkell Lindberg □□rarinsson, 2012).

Figure 63: *A view south over the southern part of the Bakkakrókur coast. Rocks, gravel and sand can be seen in the upper and lower parts of the shore, and a patch of drifted seaweed. Larger boulders and bedrock can be observed in the lower part, reaching far into the sea. Shallow basins with solid bedrock floors can be observed between the skerries . (Photo Þorkell Lindberg Þórarinsson, 2012).*

Visible shore skerries during observations were covered with seaweed and between them shallow basins with solid bedrock floors, sometimes covered with sand, rich in Corallinacea algae. The Bakki coastline (Bakkafjara), along with cape Bakkah□f□i, is on the Nature Conservation Registry, with the following description: *„Bakkafjara and Cape Bakkahöfði, Húsavík. (1) The Cape, along with coastline, outcrops and offshore. (2) Peculiar bedrock outcrops and intrusions in front of the cape. Biologically diverse shores and outcrops.“*

In the north part of Bakkakr□kur, which is similar to the above description, seaweed patches have been studied. Their division by height is apparent, with brown algae species *Fucus spiralis* at the top of the shore, *F. vesiculosus*, *Ascophyllum nodosum* and *F. distichus* lower down the shore. These species were seen in the south part of Bakkakr□kur during observation on October 29, 2012. Species communities and their division in patches are probably similar in the north part of the Bakkakr□kur shore.

The total count of smaller organisms, number of species and their density in the north part of Bakkakr□kur is relatively high compared to shores that have been studied in other parts of the Tj□rnes peninsula. Blue mussel (Mytilus edulis), Skeneopsis planorbis and the flat periwinkle (Littorina obtusata) are prominent, with high densities. No rare species nationwide have been found in the area. Considering the nature of the coast and its seaweed cover, it can be assumed that invertebrate fauna in the south part of Bakkakr□kur shore is comparable to the north part. Characteristics of impacts

7.1.3.4 Characteristics of impacts

The results show that after dilution the temperature at the surface is around 6.2□C which is only 1.2□C higher than the sea temperature (according to regulation no. 798/1999 the maximum temperature change as a result of discharge to rivers and lakes outside of dilution □ones is 2□C). The vertical current velocity 2 m below the sea surface is around 8.8 cm/sec. and the diameter of the area of impact at the surface is approximately 1.3 m per no□□le. **Figure 64** shows the outlet and the estimated area of impact around the outlet in meters.

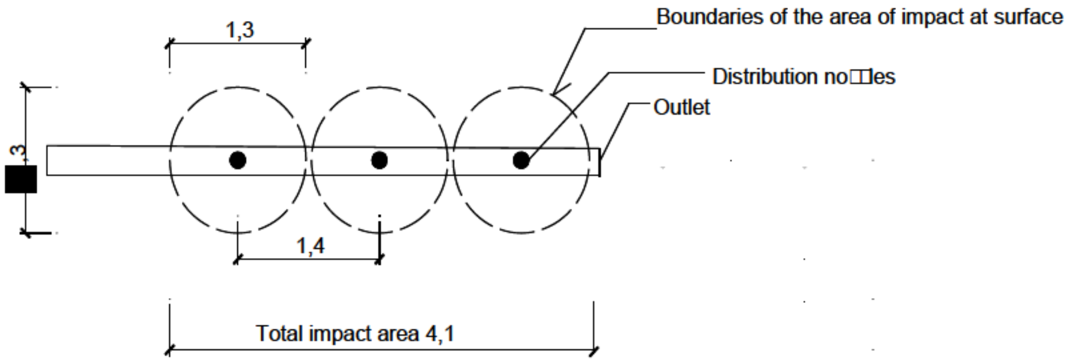


Figure 64: *Schematic figure of the impact area at the sea surface from warmed sea water release.*

Figure 64 shows that the si□e of the calculated area of impact at the sea surface is approximately 4.1 m x 1.3 m. At the boundaries of the impact area the temperature is around 6.2□C. Outside of the impact area the temperature will decrease rapidly and reach sea water temperature. The calculations show that the impact of emissions of warm sea water has very limited impact on sea temperature. Hori□ontal ocean currents in Skj□lfandafl□i are not considered in the calculations, but these currents can be of significance and assist in better mixing of warm seawater with the receiving seawater, resulting in a more rapid decreasing of the temperature. Building of the second phase will require additional sea water for cooling purposes. The cooling system will be identical compared to the system for the first phase. It is expected that the same sump pit and intake installations can be utilised, but an additional pump house and outlet to the sea parallel to the first phase outlet pipe will be constructed. The new outlet will be comparable to the first one and it is estimated that the same effects on temperature will be observed as from the existing outlet. The location and depth of the outlet will be located in appropriate distance from the existing outlet so that synergies will not be observed.

The memo from the NEINC on coastal biota and the effects of warm sea water release is based on preliminary observations, carried out at high tide on October 19, 2012 and previous studies and records of nearby seaweed shores. More detailed observations on the coastal biota could not be carried out in such late season.

From the above baseline description it is clear that the inlet pumping station and the outlet pipe will cause considerable disruption and alteration of the environment. Parts of the shore will be excavated during construction and covered with course wave breaking material, changing the nature of the shore in that area. Since these changes only take place on a limited and rather small area, they are not expected to have considerable negative impacts on the coastal biota.

Indirect long term impacts could be significant if sediments accumulate along the outlet. The outlet will likely protrude for quite some distance out to sea, given the shallow offshore depths. If there is accumulation, the outlet's impact could be greater than the outlet and wave breaker itself, due to changes in the sea floor and benthic fauna. The project's indirect impact could therefore be substantial and probably negative if sand accumulates on a large area by the outlet. Although rare species are probably not in danger, based on studies on the invertebrate fauna and algae flora in Bakkakr□kur, the accumulation of sand would probably reduce the diversity and quantity in the coastal biota at the respective area, of both invertebrates and algae.

As mentioned above, Cape Bakkah□f□i and the Bakkafjara coast are in the Nature Conservation Registry, i.e. because of its bio diverse coasts. The conserved area's boundaries may lay somewhat farther out north than the industrial area, but it is part of a larger overall ecosystem lying from H□□insv□k, where the bedrock shores begin, south along the coast to Cape Bakkah□f□i, Bakkakr□kur and Forva□i, where the sand shores recommence. The proposed project will have an impact to the overall ecosystem formed by Cape Bakkah□f□i and Bakkakr□kur shore, in spite of defined boundaries of the Nature Conservation Registry (□orkell Lindberg □□rarinsson, 2012).

7.1.3.5 Mitigation and monitoring

The effects of the outlet could be minimi□ed by situating the outlet pipes in shallow basins between bedrock cuts to minimi□e coastal surface impacted.

7.1.3.6 Conclusion

Considering the criteria mentioned above and the characteristics of the impact it is the view of the developer that the impact of the project on marine and coastal areas will be ***considerably negative*** in a limited area on the Bakkakr□kur coast.

7.1.4 Flora

The difference between this alternative and alternative 1 is that pipes have to be led from PCC to the pumping station, causing an additional impact to flora. Considering the same criteria as in chapter 6.3.1 the additional impact on flora of the alternative of using sea water cooling is considered to be negligible. This alternative is therefore considered to cause a ***considerable negative impact***.

7.1.5 Birds

7.1.5.1 Assessment criteria

The assessment of the impact on birds from the alternative of using sea water cooling on follows the same assessment criteria as for alternative 1, see chapter 6.4.1.

7.1.5.2 Documents and studies

The assessment of the impact of sea water cooling on birdlife is based and a memo on the direct effects of the construction of an inlet basin for seawater pumping and outlet pipe on the biota at the coast of Bakki, issued by biologist □orkell Lindberg □□rarinsson from the North East Iceland Nature Center (NEINC).Baseline

7.1.5.3 Baseline

The bird population was surveyed regularly in 2008 and the number of individuals counted. The survey shows that the coast at Bakki is very important for migrating birds, but around 10,000 birds pass there in the springtime. Many laying birds use the coast for resting, before continuing to their nesting ground. Many birds pass the area on their way to their northern nesting grounds. The total amount of birds is the most in mid-May when 7,000 birds are in the coastal areas.

The research area of 2008 was divided into 7 areas. Amongst the areas with the highest number of birds was the area around Bakkah□f□i and H□□insh□f□i. Flat and seaweed covered skerries/reefs, which are accessible during the tide and areas above the seashore covered with mounds of seaweed are important sources of food for birds. This makes areas such as the shoreline Bakkakr□kur an important source of food for birds such as The Red Knot (Calidris canutus), the most frequent bird at Bakki during the spring. Another important source is larvae of the seaweed fly or Coelopa frigida found in the seaweed mounds (□□rarinn Lindberg □□rarinsson, 2012).

7.1.5.4 Characteristics of impacts

As described in chapter 2.5 and 3.1, a part of the coastline will be disrupted by the construction of the possible seawater pumping station. According to the specialist of the NEINC this could cause a considerable, but temporary, negative impact on birds during construction if carried out in the springtime when the area is an important source for birds.

7.1.5.5 Conclusion

A considerable negative impact might occur due to disturbance during construction of the possible seawater intake, if carried out in spring, when the birds frequent the Bakkakr□kur coast.

7.1.6 Landscape and visual impact

The impact on landscape and the visual impact are considered to increase for this alternative due to the changes to the coastal area. The additional visual impact is from the pumping station infrastructure located at the coastline, see chapter 0.

7.1.7 Archaeological remains

The impact on archaeological remains is considered the same as for alternative 1, see chapter 6.6.

7.1.8 Social impact

Social impact is considered the same as for alternative 1. See chapter 6.7

7.1.9 Environmental impact during construction

The environmental impact during construction is considered to be similar to alternative 1. Additional impact is from the construction of the pumping station, and the inlet and outlet pipes for the sea water. The main difference between the two alternatives is due to a potential temporary impact on birds using the coast as feeding grounds, especially if this is carried out during the springtime. This is however considered not to change the overall impact as assessed for alternative 1, see chapter 0.

7.1.10 Risk and safety

The impact on risk and safety is considered the same as for alternative 1, as described in chapter 6.9.

7.1.11 Review and comments on marine and coastal areas and PCC's answers

In the report from the Marine Research Institute it says: "*It is proposed to use seawater for cooling during the production process in a closed cooling system, where the sea water does not come in contact with any pollutants but does absorb heat before it is pumped back into the ocean. The required amount of cooling water is approx. 1200 m3/h. The proposed plan is to direct the seawater back into the ocean at a depth of 5 m and at a temperature of 15-25°C when it is released through a nozzle in the south of Bakkakrókur. It is not explained in the IEIS what is the offset water level when spoken of 5 m depth of the nozzle. The Marine Research Institute considers it important that the nozzle is at a depth of 5 m in low level water to insure addictive mix to cold sea water. This is also important for the phase 2 expansion, where a cooling system, comparable to the system for phase 1 as has been discussed, will be added. Results from the research on the biology of the area don't indicate that any unique or rare species of organisms are located in the northern part of Bakkakrókur. No research has currently been performed on the southern part of Bakkakrókur, where the proposed cooling sea water will be released back into the ocean. The report (p.81) states that according to a memo from the NEINC, direct observations of the seaweed shores in the southern part of Bakkakrókur, comparable to the research performed in the northern part, are not applicable/realistic due to the season/time of year .Before the construction of the 2nd phase of the plant, the observations could be done and it is recommended that they should be performed as the area is listed in the Natural Conservation Register.*"

PCC comment: Calculations of the mixing of the released cooling seawater are based on placement of the exit nozzle at a depth of 5 m below the minimum sea level. This allows for the sufficient mixing with the colder sea water. If the seawater cooling alternative is chosen, a pre-liminary research on the seaweed shores in the southern part of Bakkakrókur will be performed before construction begins. Efforts will be made for the placement of pipes for seawater cooling to the south of the part of Bakkafjara, that is listed in the Natural Conservation Register.

7.2 Zero-option

7.2.1 Air quality and climate

According to the zero-option, no discharge of pollutants and greenhouse gasses would occur into the atmosphere from PCC's plant. The area is defined as an industrial area in the municipal plan, and other industrial development is therefore likely to be built on the site that may cause (similar) substances to be released into the atmosphere. Therefore the impact of the zero option on the local air quality is considered to be ***negligible***. It may also be argued that if the PCC plant will not be constructed at Bakki it is likely to be built elsewhere, and quite possibly in locations without access to the same amount of renewable energy sources. This may cause more net emissions than if the plant would be constructed at Bakki. Considering this, globally, the impact of the zero-option would have a negative impact, although the magnitude of increase as such may not be considered significant.

7.2.2 Noise

The effect of the zero-option would be that there would be no noise emissions that come from PCC's Silicon Metal plant. However, the area is defined as an industrial area in the municipal plan, and other industrial development likely to be built there. Calculated noise levels show that noise will be within legal requirements for industrial sites and for noise emitted to neighbouring sites. Therefore, the impact of the zero-option is considered to be negligible.

7.2.3 Marine and coastal areas

The impact of the zero option on marine and costal area involves that either alternative 1 will be built (instead of seawater cooling), or that the whole project will not be realized. The zero option involves that the shoreline and shore will remain intact, instead of being disrupted following the construction of the sea water inlet pumping station and the laying of pipes.

There will also be no risk of sediments accumulating at the outlet and the impact on sea floor and benthic fauna as well as no indirect impact following sand accumulation and no release of sea water; however the assessment of the impact of the release is that it is negligible. Considering the above, the impact of the □ero-option on marine and coastal areas will be ***considerably positive.***

7.2.4 Flora

The impact of the □ero option on flora will be that vegetation that otherwise would be lost under structures of the plant will be preserved. Wetland spots south of River Bakka□ will not be disrupted from this construction. None of the plants or high plants found in the area are considered to be in threat of extinction. The area is defined as an industrial area in the municipal plan. Considering the above, the impact of the □ero-option on flora is considered to be ***negligible***.

7.2.5 Birds

The impact of the □ero option on birds is considered ***insignificant***, due to the low value of the area for birds within PCC's site, see chapter 0. However, if comparing the □ero-option to the sea water cooling alternative, the impacts of the □ero option are considered ***negligible***, since the effect of the construction was considered to be only temporary.

7.2.6 Landscape and visual impact

The effect of the □ero-option is that no structures will be built and surface not disrupted. Therefore nothing occurs inside the area and the effects are thought to be considerably positive. The same applies to this environmental aspect as for others, that the land use is defined for industrial use and therefore very likely that structures will in the end be built in the area.

7.2.7 Archaeological remains

None of the remains found on site have a high monumental value. Provided that all mitigation measures are followed, the impact on archaeological remains is considered to be insignificant. Considering the above, the impact of the □ero option on archaeological remains is considered to be ***negligible***.

7.2.8 Social impacts

The social impact of the □ero option is that no temporary work will be created during the construction and operation of the plant, which no temporary or future positive impact on the labour force. Also the income of the municipalities will not rise as it would if the construction and operation of the plant were to take place. Considering the above the social impact of the □ero option is ***negative.*** However, the area is defined as an industrial area in the municipal plan, and other industrial development likely to be built in the area that will cause a positive social impact.

7.2.9 Risk and safety

The impact of the □ero option on risk and safety is that there will be no risk of explosions from the LPG storage, nor from the material storages. Furthermore there will be no risk from oil spillages, i.e. from transformers or stored fuel. These are however all manageable impacts and the □ero option is considered to be ***negligible***.

8 CONSULTATION AND PRESENTATIONS

8.1 Scoping Plan Proposal Draft

The Scoping Plan Proposal Draft was made accessible to the public and stakeholders for three weeks between December 1st and December 22nd, 2011 to fulfil requirements of article 14 of regulation 1123/2005 on environmental impact assessment.

The Scoping Plan Proposal Draft was advertised in Fr□ttabla□i□ and Morgunbla□i□ [national newspapers] and Skr□in in H□sav□k [local newspaper] on December 1st, 2011. The Scoping Plan Proposal Draft was advertised and accessible on the website of EFLA Consulting Engineers.

On November 13th, an open house was held at Fossh□tel H□sav□k. There, the company PCC, the project and the Scoping Plan Proposal were presented.

At the same time the developer opened a website, www.pcc.is, there the public and other parties had an opportunity to gather information on the company and the proposed project at Bakki.

8.2 Scoping Plan Proposal

The Scoping Plan Proposal was sent to the National Planning Agency and presented for commenting from January 3rd to January 17th, 2012. The Scoping Plan Proposal was accessible on the website of EFLA Consulting Engineers. Also there was a long from the website of PCC SE, www.pcc.is to the EFLA website.

The NPA consulted with the following statutory consultees in accordance to paragraph 8 of the Environmental Impact Assessment Act; the Cultural Heritage Agency of Iceland, the Marine Research Institute, the Health Inspectorate of NE Iceland, the Icelandic Construction Authority, the Municipality of Nor□ur□ing, the Environment Agency of Iceland, the Meteorological Institute and the Administration of Occupational Safety and Health.

On February 2nd, 2012 the National Planning Agency agreed to the Scoping Plan Proposal with comments.

8.3 Presentation of the Initial Environmental Impact Statement

The Initial Environmental Statement (IEIS) was sent to the National Planning Agency on February 18th, 2013 and was presented for 6 weeks, from February 22nd to April 5th, 2013. While the IEIS was in preparation the National Planning Agency, Environment Agency and Nor□ur□ing municipality were consulted in accordance with the Act on EIA.

The National Planning Agency advertised the proposed project and the IEIS in Skr□in in H□sav□k on February 21st, 2013 and in Morgunbla□i□ and Fr□ttabla□i□ on Friday February 22nd, 2013.

The report was available at the following locations

- National Planning Agency
- *National Library of Iceland*
- *Húsavík Public Library*
- *Website PCC SE, www.pcc.is*
- *Website EFLA Consulting Engineers, www.efla.is*

The project was introduced to the public and to stakeholders in an open house at Fosshotel in H□sav□k on Saturday March 9th between 14:00 and 18:00. Between 200-250 visited the open house

The National Planning Agency sent the IEIS for review and commenting to the following parties in accordance to Article 8 of the law on EIA; The Marine Research Institute, The Health Inspectorate of NE Iceland, Iceland Construction Authority, The Cultural Heritage Agency of Iceland, Nor□ur□ing municipality, Environmental Agency of Iceland, Iceland Met Office and the Administration of Occupational Safety and Health in Iceland.

The National Planning Agency received reviews from the following parties.

- The Marine Research Institute, March 4th, 2013
- The Cultural Heritage Agency of Iceland, March 13th, 2013
- Administration of Occupational Safety and Health in Iceland, March 13th, 2013
- The Health Inspectorate of NE Iceland, March 14 th, 2013
- Iceland Met Office, March *14 th, 2013*
- Iceland Construction Authority*, March 19 th, 2013*
- *Norðurþing municipality, March 20 th, 2013*
- Environmental Agency of Iceland*, March 20 h, 2013*

The National Planning Agency also received comments from Verk□s Consulting Engineers, dated March 27 th, 2013 and for „Héðinsh□f□i“ (Erla Bjarnadóttir, Héðinn Jónasson, Katý Bjarnad□ttir, Kjartan Traustason, Sigr□□ur H□rn L□rusd□ttir og Sigr□n Ingvarsd□ttir), April 3rd, 2013.

Table 19 provides an overview over the reveries and there in the EIS the answers of the developer can be found

Table 19: Chapter with reviews and comments and PCC's answers

	Summary of reviews and comments	**Where in the EIS can the answers be found?**
Marine Research Institute	The Marine Research Institute requests further explanation of the height references for the calculation of the mixing of hot sea water. Also the Institute points out that it should be possible to conduct direct observations of seaweed shores in the southern part of Bakkakr□kur before the construction of the 2nd phase of the plant, and that it is feasible to do so since this is an area listed in the Natural Conservation Register.	Answers can be found in Chapter 7.1 on sea water cooling
The Health Inspectorate of NE	The Health Inspectorate of NE Iceland (HNE) comments on the temporary storage of raw materials at the harbour area in case of temporary delays of transport between the harbour area and the plant. In the opinion of the HNE it needs to be clearly explained which materials will be stored in the harbour area and how, i.e. regarding the risk of fine blowing. It should be considered if it is necessary to build over all materials there is a risk of materials blowing. Furthermore the HNE believes that PCC should investigate recycling possibilities that are truly available in order to reduce the amount of waste for landfill as much as possible The HNE points out the methods used by the industrial installation at Grundartangi in this respect. In the review of the HNE it is noted that there is no landfill with operational permit within the municipality. The HNE considers it to be necessary to clarify the location of work camps during construction and to cover the laws and regulations on the construction and operation of work camps that is sewage, energy use, water use and waste disposal. Finally comment on noise, it says that since the results of the EIA is that the impact of noise from the operation is negligible except in the closest proximity of the plant and the harbour area it is normal that strong demands will be made on mitigation measures in order to ensure that the demand of the regulation on noise will be fulfilled.	Answers can be found in Chapter 2.13.1 (transport of materials from harbour), Chapter 2.13.3 (solid waste and by products), Chapter 2.13.4 (construction waste) and Chapter 6.2 (noise).
Iceland Construction Authority	The Iceland Construction Authority comments: „ *The report states that the current fire brigade of the municipality cannot manage the situations that can come up in relation with the operation of the plant, that it is necessary to improve both the manpower and equipment. It is important to conditioned from the beginning how*	PCC agrees to the items in the review of the Iceland Construction Agency. An emphasis will be on risk and security during the design and operation of the Silicon

	the participation of the municipality and the company in this shall be, so no licences will be issued for the construction of the plant that can cause a substantial risk of accidents without ensuring the necessary development of the fire brigade in the municipality. Structures for such operation also require fire design and risk assessment for structures and for the operation, in these respect requirements in Articles 22.-24. in the law on fire protection should be pointed out. It is logical to expect that this should be conditioned in licences for the plant, its operation and all transport to and from the plant	Metal plant.
The Cultural Heritage Agency of Iceland	In the review of the Cultural Heritage Agency of Iceland further explanation on remains on Figure 60 is requested [comment: the points in question were inserted into a map taken from the municipality master plan]. The Cultural Heritage Agency discusses those remains that need to be considerate in connection to the construction and which mitigations measures should be implemented at each time. The Agency points at Article 21 of The National Heritage Act (Nr 80/2012) states: “remains, according to Article 3(3), both them who are protected as cultural remains and those who are protected because of their age cannot be damaged, destroyed, modified, covered, altered or moved, except with the authori□ation of The Cultural Heritage Agency of Iceland. Further, the Agency points out Article 24((2) of the same Act that says: If previously unknown remains are found during work, the constructor shall stop the project without delay. The Cultural Heritage Agency of Iceland shall immediately have a survey performed to determine the nature and scale of the findings. The Agency shall determine as soon as possible if work can continue and define and set conditions. It is not permitted to continue work without the written permission of the Cultural Heritage Agency of Iceland.	Answers to the review of the Cultural Heritage Agency of Iceland can be found in Chapter 6.6 on Archaeological remains. Table 15 and Figure 60 have been updated in the EIS.
Nor□ur□ing municipality	The planning and building Committee of Nor□ur□ing provide a positive review on the IEIS and doesn’t make substantial comments on the EIA. The review points out that the project complies with the draft version of the local plan for the industrial site that is currently in presentation. Furthermore, it is stated that although a project of this magnitude always has an impact on the environment, the impact is within the company lot and its closest surrounding. The visual impact has a wide range, as is inevitable for such massive structures, but measures will be taken during the construction and operation period to reduce the negative impact. Further, it is the opinion of the planning and building Committee that the impact of the plant on the society is positive and covers Nor□ur□ing municipality, neighbouring municipalities and the entire country.	

The Environment Agency of Iceland	In its review the Environment Agency of Iceland points out that it can be of use to provide information in the EIS on the basis for the assumptions used for the assessment of the sulphur dioxide discharge. The Agency also points out that a new draft of the report on best available technique (BAT) has been issued and the Agency requests that it will be stated if the operator can comply with the requirements and limits set in the new “BAT conclusions” in the same report. In addition, the Agency calls for a discussion on dust pollution during construction and that mitigation measures against dust during construction will be described. Furthermore, the Agency points out that the operation of the Silicon Metal plant will increase Air pollution greatly, but that the calculated values to be under the reference values, though some values are close to these values. It can be assumed that pollution from sulphur dioxide can be measured in H□sav□k, but it is not expected that pollution in the town will exceed the limits of the regulations. The Agency points out the World Health Organi□ation (WHO) guiding reference values which are stricter than reference values in Icelandic and European regulations. The Agency points out the presented data in the EIA do not suggest that the guideline values of the WHO will be exceeded in the H□sav□k residential area. The Environment Agency also points out the necessity of assessing possible cumulative effect of air polluting substances following further development in the area, especially for sulphur dioxide. The Environment Agency concludes that air quality will get significantly worse compared with the current situation. The air pollution coming from PCC on Bakki, will though by it is within the reference values of Icelandic regulations. In its review on noise the Environment Agency asks the question if the mitigation measures described in the EIA are actual mitigation measures, since those would be actions that would be undertaken so that noise in the boundaries would comply with the noise regulations during operation of the plant. Also, in its review on Flora the Environment Agency suggests as a mitigation measure the recovery of wetlands instead of any vegetation disturbed, regardless of the disturbed area being wetland or not. The Environment Agency does not comment on Birdlife and Landscape and visual impacts.	Answers to the review of the Environment Agency of Iceland can be found in Chapter 6.1 (Air Quality), Chapter 6.2 (Noise) and Chapter 6.3 (Flora).
Icelandic Met Office	In its review the Icelandic Met Office comments on how wind roses are presented	Answers to the comments of the Icelandic

	in the EIA. Furthermore the Met Office assumes that a possible error might be in emission calculations, since the mean annual temperature in few weather stations in the vicinity is different than the value chosen as exhaust temperature in the calculations. Further, the Met Office believes that the water use of the operation needs to be better explained, taking into consideration the accessibility of water in the area and if the water source will withstand. The impact of cooling needs further explanation as well as which chemicals are used as additives and what danger can be created losing all water from the system in a relatively short time. Furthermore the Met Office believes that possible ha□ardous materials of waste that can pollute water or soil or will be disposed of in the municipality need to be further explained. Also the Met Office comments that it seems that the impact coming from transport of materials to and from the plant is not taken into consideration in discussion of Air Quality. The Met Office comments on the calculations of Airborne emissions. It says that further explanation is needed on the calculated values and concentration of pollutants according to the calculation models. It needs further explanation what is the highest mean concentration at each time and the uncertainties of such calculations. In those incidents where the concentration is close to the reference values they need to be further explained, that is the maximum values of the dispersion calculation, highest possible concentration and under which circumstances and how frequent this can occur. Also the Met Office comments that the scale used on Air Quality maps needs further explanation. The Met Office also comments that calculations of the 24 mean values for particle matter for 33,000 tpa and 66,000 tpa production capacities need further explanation, since maps seem to have similar dispersion but not reach the same concentration. The Met Office also comments on Table 12, since the values presented resemble mean values rather than maximum values. It is the opinion of the Met Office both values should be shown as well as the uncertainties. Finally, the Met Office comments that if other methods for release of emissions	Met Office can be found in Chapter 6.1 (Air Quality) and Chapter 2.13 (Review and comments on project information and PCC's answers). Figure 14 has been updated.

	are part of the EIA, comparable information need to be presented as are presented for release through stack.	
Administration of Occupational Safety and Health in Iceland	The Administration of Occupational Safety and Health in Iceland (AOSH) does not make substantial comments on the EIA. The AOSH points out that the company needs to apply for an operational permit to the AOSH in accordance to Article 95 of Act 46/1980 on accommodation, health and safety at work. Furthermore, based on the information on the amount of ha□ardous substances at the plant it is subject of regulation no 160/2007 on protection against major-accident ha□ard from ha□ardous substances.	It is pointed out that due to the nature of the Silicon Metal production it is very unlikely that carbon refractory linings will be used, but if that is. The regulations mentioned in the AOSH's review will be complied with.
Verk□s Consulting Engineers	Verk□s Consulting Engineers comments on that EFLA Consulting Engineers did not request further information from Verk□s other than those already submitted to EFLA by Verk□s. Verk□s says in the comment that it is incorrectly stated in the Chapter on Air Quality that uncertainty of the location of the plant [comment EFLA: The Saint Gobain plant] prevents a reliable assessment of cumulative effects.	Answers to the comments of Verk□s Consulting Engineers can be found in Chapter 6.1 (Air Quality)
Comments from residents and land owners of H□□insh□f□i	A group of people connected to the H□□insh□f□i farms comments on the possible impact on agriculture and residence at H□□insh□f□i due to the impact of the construction and operation of the Silicon Metal plant on Air Quality, Noise and because of the visual impact. It is requested that weather measurements that were made for other proposed projects in the area will be continued to provide actual date available on the weather in the region. Also the question is asked what impact machinery and other equipment used for the construction will have on the Air Quality in the area as well as residents and agriculture in the proximity of the construction area. Furthermore it is asked what the impact is for transport of waste, if the future landfill would be located in K□pasker. Also it is asked what will be happened to earth materials from land forming. It is the opinion of the people that made the comments that the impact of the construction and operation of the plant on animal life, land and people is significant and permanent. Also it is their opinion that traffic will increase, with associated discomfort. Information is requested on a comparable plant, and the impact it has on its surroundings. Also it is asked if and how it can be ensured that there is no impact on areas belonging to Tj□rneshreppur municipality.	The answers to the comments made by a group of people connected to the H□□insh□f□i farms can be found in Chapter 2.13 (Review and comments on project information and PCC's answers), Chapter 5.4 (Environmental aspects examined in the EIA), Chapter 6.1 (Air Quality), Chapter 6.2 (Noise), Chapter 6.5 (Landscape and visual impact) and in Chapter 6.8 (Environmental impact during construction).

	Also, they ask for clarification of the interpretation on the criteria used for the assessment of the visual impact, and what lies in the impact of a construction being permanent but reversible. Also questions are asked regarding the proposed mitigation measures to reduce the visual impact and noise. It is also stated that those signing the letter doubt the result of the EIA that the environmental impact from the PCC Silicon Metal plant at Bakki is acceptable. A confirmation is requested that the Silicon Metal plant will not reduce the quality of life for residents and land owners at H□□insh□f□i and that the Silicon Metal plant has no impact on cultivation, agriculture and ecology of H□□insh□f□i and that property values of real estates and structures will not be reduced during construction and operation of the plant.	

9 RESULTS

9.1 Summary of the Environmental Impact

Table 20 gives a summary of the impact of the proposed project on the individual environmental aspects, taking into consideration the criteria and the character of the impact over a long period of time. The definitions of the weighted rating used can be found in **Table 9**, in chapter 7.4.

Table 20: *Summary of the Environmental Impact.*

Environmental aspect \ Weighted rating	Substantial positive impact	Considerable positive impact	Negligible	Considerable negative impact	Substantial negative impact	Uncertainty
Air quality and climate			X			
Noise			X			
Marine and coastal areas (other alternatives)				V		
Flora				X		
Birdlife			X			
Landscape and visual impacts				X		
Archaeological remains			X			
Social impact		X				
Environmental impact during construction			X	(X)		
Risk and Safety			X			

Table 20 shows that the construction of the PCC SE silicon metal plant will have an negligible impact on Air Quality and climate, noise, marine and coastal areas, birdlife, archaeological remains and risk and safety, negligible or temporary considerable negative environmental impact during construction, considerable positive social impact and considerable negative impact on flora and landscape and visual factors. If the alternative with sea cooling is chosen, the construction will have a considerable negative impact on marine and coastal areas and birdlife, especially if it takes place in the spring, but the impact will be similar on other environmental aspects. The main results for each environmental aspect are as follows:

Air Quality and Climate

The effects of emissions on the Air Quality were modelled. The results showed an increase in the concentration of particle matter (PM10), sulphur dioxide (SO_2) and ammonia dioxide (NO_2), the estimated concentration is within the regulatory limit. The release of polycyclic organic pollutants (POP), polycyclic aromatic hydrocarbons (PAH) and ben□o (a) pyrene (BaP) is low and well within the reference values. The production process will release considerable amounts of carbon dioxide (CO_2), the increase is within the boundaries of the expected increase in CO_2 levels, through 2020, according to the government's action plan on climate change. Emissions from PCC, when combined with emissions from other metal production companies within the assigned industrial area, can result in an increased risk of cumulative effects due to the release of chemicals in the atmosphere. Additional information of the location and release of chemicals by other companies is required for further analysis. The cumulative effects are considered to be local and dependant on specific weather conditions. With regards to the nature and scope of the effects on air quality and climate, the effects of the project are considered to be negligible.

Noise

Noise from the operation of a Silcon metal plant comes from both daily operation of the plant and harbour operations associated with the plant (i.e. unloading, loading and transportation to/from the plant). To estimate the noise effects, a model of the noise distribution was developed and the sound level calculated. Where residential areas are in close proximity to industrial area, the acoustics will meet the regulatory limits for noise due to both traffic and operations. The regulatory limits for noise will not be met without mitigation measures at the plant site boundaries due to close proximity of major noise contributors such as fans on dedusting, transformers and furnaces. The effects of the silicon metal plant in Bakki on noise are considered to be **negligible**, except in close proximity to the plant site and the harbour where tasks associated with it are performed.

Flora

The impact evaluation is based on field research, national registry and previous studies. In total, 108 species of high plants were found in the research area, mostly dry land plants since little wetland is in the research area. A few mosses, lichens and fungi species were identified, but no special focus was on the collection or analysis of these organisms. Heathland is prominent in the area but there are also spots where grasses are prevalent and eroded areas with spreading Alaska lupine. Wetland is mostly found in the northernmost part, in proximity to River Bakka□. No red list plant species were found during field research or in recent studies. The environmental impact of the project is mainly due to loss of vegetation removed during constructions, i.e. buildings, roads and car parks. Impacts on wetland vegetation near River Bakka□ are not expected due to changes in the riverbed and flow.

The proposed project is considered to have a ***considerable negative impact*** on vegetation and, since vegetation cover will be disrupted and the changes are irreversible. Possible mitigation measures include land reclamation using Icelandic plants, common in the area.

Birds

The impact on birdlife is based on field research, previous studies, international agreements and lists of species in threat of extinction and rare species. Based on observations and previous studies, 17 bird species are believed likely to breed in the research area, many of which are considered responsibility species in international cooperation. Breeding densities of grassland or heathland birds is assumed high in the investigation area. Bird species that are subject to impact due to the project are common, both nationally and within the region. Since the area of impact is relatively small, the construction is not believed to have an impact on the population si□e of species that breed on the industrial area or use the site in any other way. The proposed project is assumed to have a considerable negative impact on birdlife **within** the site.

Landscape and Visual Impacts

The effects of the Silicon Metal plant on the visual appearance of the area are foremost due to the proposed buildings at the plant site, with contributions from landscaping and land forming

The most apparent proposed structures are the furnace building and casting area with a height of 37,5 m, filter plant and raw material storage facilities at a height of 27 m and product crushing and storing at a height of 24m. All other structures have a considerable less height and therefore impact.

The effects on landscape are only thought to be local, but considerable within the plant site. No areas that are thought to have value due to their landscape features will be disrupted.

The effects on landscape are ***considerably negative*** permanent but reversible.

The Silicon Metal plant will generally not touch the skyline, since the lot is located in a slope and structures are therefore covered by land from most viewpoints. Though, it can be assumed that structures will be visible and touch the skyline seen from the national road and from the houses at Héðinshöfði 1 and 2. A reduction of view is small, but evident from areas north of the plant.

The visual impact is ***considerably negative***, permanent but reversible from areas north of the plant and from above, that is from the national road, from Gónhóll and other areas close to the plant. The impact is permanent but reversible. The plant is not visible from Húsavík.

Archaeological Remains

The impact on archaeological remains was assessed on the basis of two archaeological studies, national registration and the National Heritage Act. A total of 21 remains were found in the studies, including an old path, mounds and a burial site. The mean preservation values of remains situated in the area south of River Bakkaá is 2.5, which is considered low, and none is believed in need of protection. The highest value (7) is assigned to remains at a location with a supposed fox trap. In this area, it is the archaeologist's opinion that the effects of the project are highly acceptable, assuming full consideration during and after construction and taking appropriate mitigation measures if needed. Appropriate mitigation measures include recording the exact location, digging examination ditches and labelling remains. In the study performed in the area at and around River Bakkaá, the remains are considered to be at risk due to the proposed project. No monumental value was assigned to those remains, but labelling is suggested to reduce the risk of disruption. If disruption cannot be avoided, authorization must be granted by the Archaeological Institute that also decides appropriate procedures and measures to be taken. Assuming all mitigation measures be taken where and when necessary, the impact is regarded as ***negligible***.

Environmental Impacts during construction

The assessment of environmental impacts during constructions focuses mainly on the temporary impacts on residents in Húsavík and nearby areas, i.e. due to transport of building materials, operation of heavy machinery and site preparation during construction. The plant will be constructed on an industrial property north of Húsavík, the closest houses situated approximately 1.2 km away from the south border of the plant's site. Given the distance from the village to the plant's site, it is unlikely that noise from on-site construction work will have an impact on residents of Húsavík. During hot and dry weather periods earth works might however cause dust pollution. This can be avoided by covering truckloads and spraying eroded areas during dry periods. Assuming the new road from the harbour to the plant's site is ready before beginning construction, and that appropriate mitigation measures are taken, the project will have a negligible impact on residents during the plant's construction, mainly due to increased traffic and noise. This impact is estimated to increase to considerable

negative effect if the new road is not ready before plant construction, due to decreased traffic safety and increased noise.

These effects can be limited to an acceptable degree with several methods, such as selected transportation timing, definition of main transportation routes and marking of them.

Social Impacts

The assessment of the social impact of the project, both during construction and operation, is based on a previous EIA study and a study on the infrastructure in Northeast Iceland. The assessment focuses on impacts on population development, the labour market and on the municipalities in the region. The local region of H□sav□k showed a population decline over a ten year period 2001-2010, especially among children and young adults. Services and administration within the municipalities can mostly accommodate a significant increase in population without having to expand, with the exception of pre-schools and health services. The construction of the Silicon Metal plant is believed to create around 200 man-years during the construction, and is considered to have a temporary positive impact on population development; labour force and the municipalities, due to jobs created and increased service demands from the municipalities, especially in health services. The operation of the plant will provide new permanent jobs; not including jobs created indirectly in relation to the project, and create revenues for the municipalities. The operation of the plant will therefore have a substantial ***positive*** impact on the population development, labour force and the municipalities.

Risk and Safety

The assessment of impacts due to risks to the health and safety of people and the safety of the environment is based on acts and regulations on buildings and structures; fire safety and other safety regulations; and documents on natural ha□ards, especially concerning earthquakes. The main risk issues are the risk of explosion where LPG is stored and risk of dust explosion in the material storages. The operation is planned in a seismic region, but other natural catastrophes are no significant threat to the operation. Risk management will be carried out to mitigate risk and to ensure they are dealt with appropriately. Performance based safety design and risk analysis will be carried out for the appropriate buildings, i.e. the storage of flammable gasses and raw materials and the risk factor accounted for in the design. All systems, i.e. fire detection and suppression systems, egress paths, fire fighting facilities etc. be according to regulations. The structures will be designed for appropriate seismic loads and fire. Risk analysis will be done on the effect of exhaust, waste, gas leakage or other factors and the effect on the health of people, property and the environment. Transformers, large fuel loads in storage facilities and the storage of LPG and oxygen call for the capacities of the fire brigade at H□sav□k to be expanded. PCC will prepare a response plan on acute pollution of the sea in connection with an application for an operation permit. No raw materials transported through the port and used by PCC can cause acute pollution of the sea. Oils within transformers and fuel oil will be kept on site and proper safety cautions will be carried out for those. With appropriate measures, the emerging risks from the operation at Bakki can be minimised and the environmental impact due to ha□ardous events kept to a minimum. The effects are therefore considered to be ***negligible***.

Ocean and coastal areas (*Other alternatives – Sea water cooling*)

One option for cooling heat formed during the production is the use of seawater. This option can cause effects due to heat dispersion from cooling water and direct effects on the biota at the coast of Bakki. The cooling system itself will be closed and therefore no risk of pollution due to emission from the system. Calculations of the impact of the release of warm seawater at 5 meters depth show an impact area where the temperature rises by 1.2□C, which is below the maximum temperature of 2□C allowed to rivers and lakes outside of dilution □ones. This calculation was carried out for both phases with similar results.

The construction of the seawater intake infrastructure will cause considerable disruption and alteration of the environment on a limited area at the Bakkakr□kur shoreline, when parts of the shore will be excavated and covered with course wave breaking material. Although the construction itself is considered insignificant in comparison with the area it is affecting the long term impact is considered to be significant if sediments accumulate along the outlet and cause changes in the sea floor and benthic fauna. Furthermore, the accumulation could reduce diversity and quantity of costal biota. A possible mitigation measure is to situate the outlet pipe in shallow basins between the bedrock cuts to minimi□e the coastal surface impacted. It is therefore the conclusion that the impact of the option of sea water cooling can cause a ***considerable negative impact*** on a limited area on the Bakkakr□kur coast.

Other aspects of the proposed Silicon Metal plant will not affect marine and coastal areas in any way.

Results

There will always be some environmental impact with a project of this magnitude. The direct effects of major factors, i.e. visual impact, are isolated to the plant site and areas in close proximity. The proposed PCC Silicon Metal plant will be located on an industrial site, just to the north of H□sav□k. During the construction and operation of the plant, mitigation measures will be taken to minimi□e the environmental impact from the plant. The positive effect on the community is most apparent and would reach Nor□ur□ing as well as neighbouring municipalities. Overall, the developer concludes that the environmental impact of the proposed PCC Silicon Metal plant is ***acceptable.***

9.2 Mitigation measures

In general it can be said that during the preparation of the project the view prevailed to reduce the impact on most of the environmental aspects. In the EIA, however, mitigation measures listed below have been proposed the minimi□e the impact of the construction. No mitigation measures were suggested for the impact on air quality or society.

Noise

In the design and layout of the activity regarding the PCC Silicon Metal plant the noise emission will be taken into account and arrangements made such that the impact of the noise emission will be minimi□ed. To fulfil the noise criteria at the site boundary it is advised to simply move the northern boundaries to the road. There is also the possibility to use noise barriers but whereas the noise sources are high up the effectiveness of the barrier is not considered enough to decrease the level significantly at the boundaries, unless the barriers is relatively high. However, it is preferable to move the crushing and its secondary dedusting from the boundary of the site to a more central location at the site if possible gt v□ri hins vegar a□ flytja hreinsivirki fyrir afsog fr□ byggingum sunnar □ l□□ina, fj□r skrifstofubyggingunni.

Flora

Given that the vegetation within site is common and does not have specific conservation value it is not considered necessary to consider reclamation in other areas due to disruption within the site. It is recommended as a mitigation measure that PCC reclaims wetlands to the same extent as disturbed. During design, the disturbance of wetlands will be avoided as possible and no changes are planned to the River Bakka□ or because of the construction. No wetland above 3 ha exists within the site. It is recommended to use local plants to reclaim green areas within the site, i.e. heathland could be removed before disruption of the area, and put on eroded areas on site.area

Landscape and visual impact

When designing the structure and shaping of the land on the industrial site it will be attempted to reduce visual impacts as possible.

Archaeological remains
The impact on archaeological remains can be minimised with i.e.: measuring via GPS, examination ditches, digging of security holes and/or complete investigations. Work sheds or other infrastructures will not be placed to close to the remains. Mitigation measures instructed by the Archaeological Officer of NA Iceland will be followed.

Environmental Impact during Construction
In order to minimi□e impacts on residents of Húsavík during the plant's construction, all traffic will be directed to a industrial road that is to be built prior to the plant's construction. Should there be a delay in the road's construction; measures will be taken to reduce the impact, i.e by reducing speed. Dust pollution will be avoided by covering truckloads carrying building material and dry and eroded areas will be sprayed with water to prevent dust from spreading during dry periods of the plant's construction. Working hours for blasting and other construction will be limited to fulfil the requirements of the noise regulations. Residents close to the area will be notified before starting the project. When preparing tender documents for the construction relevant clauses will be set on the work and handling of explosives to ensure that disturbance for nearby residents is as little as possible. The developer will insure that the contractor complies with laws and regulations regarding the working hours and npise and air pollution.

Risk and safety
Risk management in accordance to ISO 31000 will be applied to mitigate the apparent and emerging risks. Performance based fire safety design and a risk analyses will be carried out for the appropriate buildings. Storage of flammable gas will be in an isolated storage that is approved by the authorities. Where there is a risk of explosion, requirements for pressure relieving systems and structural integrity will be fulfilled. Risk analyses will be carried out for the buildings to minimi□e risks due to radiation, smoke, toxic gases or explosions. Location and storage construction for LPG pressure containers will be according to standard and the usage of equipment using LPG in accordance with the regulation. Location, venting and signs for oxygen storages will be according to standard. Risk of explosions both where LPG is stored and in the coal and woodchip storages will be accounted for. General design of storage facilities, electrical design and design of systems for the prevention/mitigation of explosions. Detection, alarm and suppression systems, egress paths, smoke control, fire fighting facilities, structural fire design and other special requirements made by regulations will be satisfied. Design of automatic suppression systems will be according to standard, but they are subject to approval of local authorities. Structures will be designed for the appropriate seismic loads. Risk analyses will be carried out where the health of people, property and the environment can be affected by exhausts, waste, gas leakage or other factors. Response plans will be made for the whole operation with special emphasis on the components that cause risk to people, environment or operation during and after an earthquake.

Marine- and coastal areas and birds (other alternatives)
The effects of the outlet could be minimi□ed by situating the outlet pipes in shallow basins between bedrock cuts to minimi□e coastal surface impacted. It will be avoided to carry out the construction at springtime when the number of birds is the highest.

Ver□i sj□k□ling n□tt til k□lingar □k□livatni ver□ur dregi□ □r □hrifum me□ □v□a□ leggja lagnir sem n□ □sj□ □grunns□ vi milli klappa og skerja til a□ l□gmarka yfirbor□srask. For□ast ver□ur a□ framkv□ mdir s□u □vorin □egar fj□ldi fugla er □h□marki.

9.3 Suggestion of monitoring and environmental audit

In preparation of the building permit and tender documents for the construction of the silicon metal plant a detailed Health, Safety and Environmental (HSE) program will be prepared which covers issues that are related to risk of pollution, security and conduct during the construction period. Also this will ensure regular inspections and auditing with inspectors from the buyer , the municipality and representatives of the Environment Agency and the Health Inspectorates. PCC will prepare an environmental audit in consultation with the parties mentioned above when the construction is completed.

In terms of monitoring of environmental aspects the following should be mentioned:

- Baseline studies will be conducted on the concentration of sulphur dioxide in grass and in leaves in previously chosen areas and the possible increase in the concentration of sulphur dioxide assessed every 2 years. Also baseline measurements will be conducted on the concentration of sulphate and on the acidity in River Bakka at the beginning of the plant operation to asses if there is an impact that can be related to the operation of the silicon metal plant. It this turns out, the measurements will be continued.
- Sound level measurements are for seen after the completion of phase 1 and later after completion of phase 2. Also sound level measurements will be conducted as a part of a monitoring plan in the operation permit.

Parallel to work on the environmental impact assessment a draft proposal of the operation permit for the silicon metal plant has been prepared that can be seen in Annex 5. The draft contains a proposal for a monitoring plan that would act as a part of the operators internal auditing. The monitoring plan covers measurements in the exhaust, in cooling water and of sound pressure levels. The final plan will be presented to the Environmental Agency of Iceland at least one year before start-up of the plant and it is a subject of an approval by the Agency.

Table 21: *Proposal of a monitoring plan according to the operation permit draft proposal.*

Pollutant/ source	Measuring point	Period	Unit	Frequency
Dust	Exhaust from bag house filter	Annual measurement	mg/Nm^3	Yearly
Dust	Treated exhaust from tapping	Annual measurement	mg/Nm^3	Yearly, from stack
Dust	Untreated from casting bay	Annual measurement	mg/Nm^3	Yearly from one exhaust
Dust	Total dust from exhaust	Year	ton dust / year	Calculated amounts from production
Sulphur dioxide (SO_2)	Exhaust from bag house filter	Year	ton SO_2 / year	Calculated amount from measurements of content in raw materials
Cooling water	Cooling system	Annual measurements	pH or mg/l	Yearly sample set
Noise	Lot boundaries	Sound pressure levels for 12 h, day 07-19 and night 19-07	Sound pressure levels	Measurements when each phase is in operation

PCC will also perform an audit on polycyclic aromatic hydrocarbons in the exhaust at least every 5 years and the audit will cover those substances listed in Article 7 of regulation nr. 410/2008. Also, heavy metals in the silica dust will be measured at least every 5 years. PCC will document the results of monitoring in the Environmental Report that will be published parallel to the company's green accounting report.

9.4 Results

There will always be some environmental impact with a project of this magnitude. The direct effects of major factors, i.e. visual impact, are isolated to the plant site and areas in close proximity. The proposed PCC Silicon Metal plant has a proposed location on an industrial site, just to the north of H□sav□k. During the construction and operational period, mitigation measures will be taken to minimi□e the environmental effects of the plant. The positive effect on the community is most apparent and would reach Nor□ur□ing and neighbouring municipalities. Overall, the developer concludes that the environmental effects of the proposed PCC Silicon Metal plant are acceptable.

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